CHAPTER 1 Solutions Key
Foundations for Geometry

ARE YOU READY? PAGE 3

1. C

2. E

3. A

4. D

5. $7\frac{1}{2}$ in.

6. $2\frac{1}{2}$ cm

7. 100 yd

8. 10 ft

9. 30 in.

10. 15.6 cm

11. $8y$

12. $-2x + 56$

13. $-x - 14$

14. $-2y + 31$

15. $x + 3x + 7x$
$= 11x$
$= 11(-5)$
$= -55$

16. $5p + 10$
$= 5(78) + 10$
$= 390 + 10$
$= 400$

17. $2a - 8a$
$= -6a$
$= -6(12)$
$= -72$

18. $3n - 3$
$= 3(16) - 3$
$= 48 - 3$
$= 45$

19. (0, 7)

20. (−5, 4)

21. (6, 3)

22. (−8, −2)

23. (3, −5)

24. (6, −4)

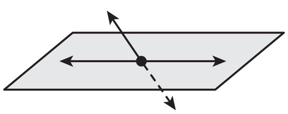
1-1 UNDERSTANDING POINTS, LINES, AND PLANES, PAGES 6–11

CHECK IT OUT!

1. Possible answer: plane $\mathcal{R}$ and plane *ABC*

2.


3. Possible answer: plane *GHF*

4.


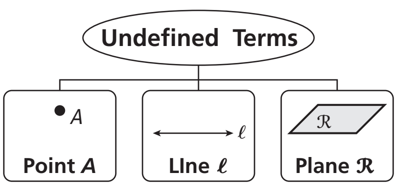
THINK AND DISCUSS

1. By Post. 1-1-1, through any 2 pts. there is a line. Therefore any 2 pts. are collinear.

2. Post. 1-1-4

3. Any 3 noncollinear pts. determine a plane.

4. $\overleftrightarrow{AB}$, $\overline{AB}$, $\overrightarrow{AB}$, $\overrightarrow{BA}$; 0 planes

5.


EXERCISES

GUIDED PRACTICE

1. Possible answer: the intersection of 2 floor tiles

2. *S*

3. *A*, *B*, *C*, *D*, *E*

4. Possible answer: $\overleftrightarrow{AC}$, $\overleftrightarrow{BD}$

5. Possible answer: *ABC* and $\mathcal{N}$

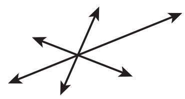
6. Possible answer: *B*, *C*, or *D*

7.


8.


9. Possible answer: $\overleftrightarrow{AB}$

10. Possible answer: plane *ABD*

11.


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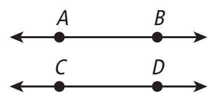


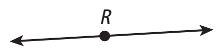
PRACTICE AND PROBLEM SOLVING

13. *B*, *E*, *A*

14. Possible answer: *B*, *C*, *D*, *E*

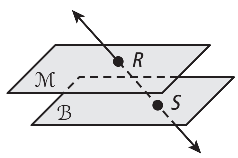
15. Possible answer: plane *ABC*

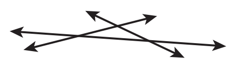
16.


17.


18. Possible answer: *G*, *J*, and ℓ

19. Possible answer: planes $\mathcal{T}$ and $\mathcal{S}$

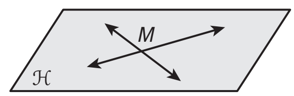
20.


21.


22a. Possible answer: tip of a stake

b. Possible answer: string

c. Possible answer: grid formed by string

23.


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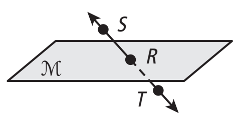


25. *U*

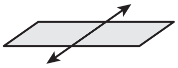
26. *U*

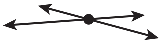
27. *U*

28. If 2 pts. lie in a plane, then the line containing those pts. lies in the plane.

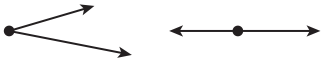
29. If 2 lines intersect, then they intersect in exactly 1 pt.

30. It is not possible. By Post. 1-1-2, any 3 noncollinear pts. are contained in a unique plane. If the 3 pts. are collinear, they are contained in infinitely many planes. In either case, the 3 pts. will be coplanar.

31. A; 

32. N; 

33. A; 

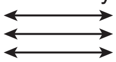
34. S; 

35. Post. 1-1-3

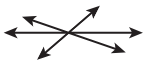
36. There are 4 outcomes: (A, B, C), (A, B, D), (A, C, D), (B, C, D); only collinear outcome is (A, B, C). So probability is $\frac{1}{4}$.

37. Post. 1-1-2

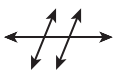
38. Lines may not intersect: 0 pts. of intersection.



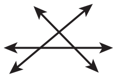
All 3 lines may intersect in 1 pt.



Two of the lines may not intersect, but they might each intersect a third line.



Each line may intersect each of the other lines.



TEST PREP

39. C; Other 3 sets are collinear.

40. F; Greatest number is when each pair of lines has separate intersection; there are 6 pairs of lines.

41. D; The 2 walls are planes, and they meet in a line.

42. 4; Greatest number is when each triple of pts. determines a separate plane; there are 4 triples of pts.

CHALLENGE AND EXTEND

43. 6

44. Among 10 pts, there are 45 pairs of pts. Therefore maximum is 45 segs.

45. Maximum = number of pairs of pts.
1st pt. can be chosen in n ways. 2nd pt. can be chosen in $n - 1$ ways. In this way, each pair is counted twice. Therefore
maximum = $\frac{n(n-1)}{2}$.

46. Rescue teams can use the principles of Post. 1-1-1 and Post. 1-1-4. A distress signal is received by 2 rescue teams. By Post. 1-1-1, 2 pts. determine a line. So 2 lines are created by the 3 pts., the locations of the rescue teams and the distress signal. By Post. 1-1-4, the unique intersection of the 2 lines will be the location of the distress signal.

SPIRAL REVIEW

47. Age of mother = a
Age of each daughter = $a - 25$

$$\begin{aligned} a + 2(a - 25) &= 58 \\ 3a - 50 &= 58 \\ \underline{+50} \quad & \underline{+50} \\ 3a &= 108 \\ \frac{3a}{3} &= \frac{108}{3} \\ a &= 36 \end{aligned}$$

Mother is 36. Daughters are $36 - 25 = 11$.

48. Yes, each element in the range is assigned to exactly one element in the range.

49. No, since the x-value 10 is assigned to the y-value 6 and the y-value -6.

50. $\text{mean} = \frac{\Sigma x}{n} = \frac{34}{8} = 4.25$

$\text{median} = \frac{3 + 5}{2} = 4$

mode: none

51. $\text{mean} = \frac{\Sigma x}{n} = \frac{2.21}{5} = 0.442$

median = 0.44

mode = 0.44

1-2 MEASURING AND CONSTRUCTING SEGMENTS, PAGES 13–19

CHECK IT OUT!

1a. $XY = \left|5 - 1\frac{1}{2}\right| = \left|3\frac{1}{2}\right| = 3\frac{1}{2}$

b. $XZ = \left|-3 - 1\frac{1}{2}\right| = \left|-4\frac{1}{2}\right| = 4\frac{1}{2}$

2. Check students' work.

3a.
$$\begin{aligned} XZ &= XY + YZ \\ 3 &= 1\frac{1}{3} + YZ \\ \underline{-1\frac{1}{3}} \quad & \underline{-1\frac{1}{3}} \\ 1\frac{2}{3} &= YZ \end{aligned}$$

b.
$$\begin{aligned} DF &= DE + EF \\ 6x &= 3x - 1 + 13 \\ 6x &= 3x + 12 \\ \underline{-3x} \quad & \underline{-3x} \\ 3x &= 12 \\ \frac{3x}{3} &= \frac{12}{3} \\ x &= 4 \\ DF &= 6x \\ &= 6(4) = 24 \end{aligned}$$

4. Let current location be X, and location of new drinks station be T.

$$\begin{aligned} XT &= \frac{1}{2}XY \\ &= \frac{1}{2}(1182.5) = 591.25 \text{ m} \end{aligned}$$

5. Step 1 Solve for x.

$$\begin{aligned} RS &= ST \\ -2x &= -3x - 2 \\ \underline{+3x} &\quad \underline{+3x} \\ x &= -2 \end{aligned}$$

Step 2 Find RS, ST, and RT.

$$\begin{aligned} RS &= -2x \\ &= -2(-2) = 4 \\ ST &= -3x - 2 \\ &= -3(-2) - 2 = 4 \\ RT &= RS + ST \\ &= 4 + 4 = 8 \end{aligned}$$

THINK AND DISCUSS

1. Since R is the mdpt. of $\overline{ST}$, you know $SR = RT$. Also, $ST = SR + RT$. By subst., $ST = SR + SR = 2SR$. So ST is twice SR.

2.

B **is between *A* and *C*.**	***B*** **is the mdpt. of $\overline{AC}$.**
A B C $AB + BC = AC$	A B C $AC = 2BC = 2AB$ $AB = BC$

EXERCISES

GUIDED PRACTICE

1. $\overline{XM}$ and $\overline{MY}$

2. distance

3. $AB = |1 - (-2.5)|$
$= |3.5|$
$= 3.5$

4. $BC = |3.5 - 1|$
$= |2.5|$
$= 2.5$

5. Check students' work.

6.

$$\begin{aligned} AC &= AB + BC \\ 15.8 &= 9.9 + BC \\ \underline{-9.9} &\quad \underline{-9.9} \\ 5.9 &= BC \end{aligned}$$

7.

$$\begin{aligned} MP &= MN + NP \\ 5y + 9 &= 17 + 3y \\ \underline{-3y} &\quad \underline{-3y} \\ 2y + 9 &= 17 \\ \underline{-9} &\quad \underline{-9} \\ \frac{2y}{2} &= \frac{8}{2} \\ y &= 4 \\ MP &= 5y + 9 \\ &= 5(4) + 9 = 29 \end{aligned}$$

8. Let road sign be R, Sacramento be S, Oakland be O, and location of picnic area be P.

$$\begin{aligned} RS + SO &= RO \\ 23 + SO &= 110 \\ \underline{-23} &\quad \underline{-23} \\ SO &= 87 \\ RP &= RS + SP \\ &= RS + \frac{1}{2}SO \\ &= 23 + \frac{1}{2}(87) = 66.5 \text{ mi} \end{aligned}$$

9. Step 1 Solve for x.

$$\begin{aligned} JL &= 2JK \\ 4x - 2 &= 2(7) \\ 4x - 2 &= 14 \\ \underline{+2} &\quad \underline{+2} \\ \frac{4x}{4} &= \frac{16}{4} \\ x &= 4 \end{aligned}$$

Step 2 Find KL and JL.

$$\begin{aligned} KL &= JK = 7 \\ JL &= 4x - 2 \\ &= 4(4) - 2 = 14 \end{aligned}$$

10. Step 1 Solve for y.

$$\begin{aligned} DE &= EF \\ 2y &= 8y - 3 \\ \underline{-8y} &\quad \underline{-8y} \\ -6y &= -3 \\ \frac{-6y}{-6} &= \frac{-3}{-6} \\ y &= 0.5 \end{aligned}$$

Step 2 Find DE, EF, and DF.

$$\begin{aligned} DE &= 2y \\ &= 2(0.5) = 1 \\ EF &= 8y - 3 \\ &= 8(0.5) - 3 = 1 \\ DF &= DE + EF \\ &= 1 + 1 = 2 \end{aligned}$$

PRACTICE AND PROBLEM SOLVING

11.

$$\begin{aligned} DB &= \left|\frac{2}{3} - \left(-5\frac{1}{4}\right)\right| \\ &= \left|\frac{8}{12} + 5\frac{3}{12}\right| \\ &= \left|5\frac{11}{12}\right| \\ &= 5\frac{11}{12} \end{aligned}$$

12.

$$\begin{aligned} CD &= \left|-5\frac{1}{4} - (-2)\right| \\ &= \left|-3\frac{1}{4}\right| \\ &= 3\frac{1}{4} \end{aligned}$$

13. Check students' work.

14.

$$\begin{aligned} CE &= CD + DE \\ 17.1 &= CD + 8 \\ \underline{-8} &\quad \underline{-8} \\ 9.1 &= CD \end{aligned}$$

15.

$$\begin{aligned} MR &= MN + NR \\ 5x - 3 &= 2.5x + x \\ 5x - 3 &= 3.5x \\ \underline{-5x} &\quad \underline{-5x} \\ -3 &= -1.5x \\ \frac{-3}{-1.5} &= \frac{-1.5x}{-1.5} \\ 2 &= x \\ MN &= 2.5x \\ &= 2.5(2) = 5 \end{aligned}$$

16. Total yards = pass + run

$= (24 - 9) + \frac{1}{2}(50 - 24) = 28$ yd

17. Step 1 Solve for x.

$$\begin{aligned} DE &= EF \\ 2x + 4 &= 3x - 1 \\ \underline{-2x} &\quad \underline{-2x} \\ 4 &= x - 1 \\ \underline{+1} &\quad \underline{+1} \\ 5 &= x \end{aligned}$$

Step 2 Find DE, EF, and DF.

$$\begin{aligned} DE &= 2x + 4 \\ &= 2(5) + 4 = 14 \\ EF &= 3x - 1 \\ &= 3(5) - 1 = 14 \\ DF &= DE + EF \\ &= 14 + 14 = 28 \end{aligned}$$

18.

$$\begin{aligned} PQ &= \frac{1}{2}PR \\ 3y &= \frac{1}{2}(42) \\ 3y &= 21 \\ \frac{3y}{3} &= \frac{21}{3} \\ y &= 7 \\ QR &= \frac{1}{2}PR \\ &= \frac{1}{2}(42) = 21 \end{aligned}$$

19a. C is the mdpt. of $\overline{AE}$.

b.

$$\begin{aligned} EF &= 2(AC) + 2 \\ &= 2(7) + 2 = 16 \\ AB &= 2(EF) - 16 \\ &= 2(16) - 16 = 16 \end{aligned}$$

20. $GH = 9\frac{1}{3}$

21. $EF = \frac{1}{2}(DF)$
$= \frac{1}{2}(CD)$
$= \frac{1}{2}(14.2) = 7.1$

22. $GH = 2(DH)$
$4x - 1 = 2(8)$
$4x = 17$
$x = 4.25$

23. $CF = 2(CD)$
$2y - 2 = 2(3y - 11)$
$2y - 2 = 6y - 22$
$20 = 4y$
$y = 5$
$CD = 3y - 11$
$= 3(5) - 11 = 4$

24. A;

25. S; 

26. A; 

27. $AM \cong MB$ is incorrect. The statement should be written as $\overline{AM} \cong \overline{MB}$, not as two distances that are $\cong$.

28. Let x be length of shorter piece. Let A and B be ends of dowel, and let C be cut point, nearest to A.
$AC + CB = 72$
$x + 5x = 72$
$6x = 72$
$\frac{6x}{6} = \frac{72}{6}$
$x = 12$
$AC = x = 12$
$CB = 5x$
$= 5(12) = 60$
Dowel pieces are 12 cm long and 60 cm long.

29. $MN = |x_N - x_M|$
$4 = |x_N - 2.5|$
$\pm 4 = x_N - 2.5$
$x_N = 2.5 \pm 4$
$= 6.5 \text{ or } -1.5$

30. 

Possible answer: $\overline{DE} + \overline{EF} = \overline{DF}$

31. $RS + ST = RT$
$7y - 4 + y + 5 = 28$
$8y + 1 = 28$
$8y = 27$
$y = 3.375$

32. $RS + ST = RT$
$3x + 1 + \frac{1}{2}x + 3 = 18$
$\frac{7}{2}x + 4 = 18$
$\frac{7}{2}x = 14$
$\frac{2}{7}\left(\frac{7}{2}x\right) = \frac{2}{7}(14)$
$x = 4$

33. $RS + ST = RT$
$2z + 6 + 4z - 3 = 5z + 12$
$6z + 3 = 5z + 12$
$z + 3 = 12$
$z = 9$

34. B is not between A and C, because A, B, and C are not collinear.

35. Check students' constructions.

TEST PREP

36. D
Order of pts. P, Q, S, R, T.
$PQ + QS + SR + RT = PT$
$\frac{1}{2}QR + QR + RT = PT$
$\frac{1}{2}(8) + 8 + RT = 34$
$12 + RT = 34$
$RT = 22$

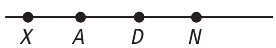
37. J
$AD = 2AC$
$= 2(2BC)$
$= 4BC$
$= 4(12) = 48$

38. B
Statement must refer to segments $\overline{XY}$ and $\overline{YZ}$, and use $\cong$ symbol for congruence.

39. H
Think: In $AC = AB + BC$, subst. BC for AB and CD for BC.
$AC = AB + BC$
$= BC + CD$
$= BD = 16$
$AC + CE = AE$
$16 + CE = 34$
$CE = 18$

CHALLENGE AND EXTEND

40. $JK = \frac{1}{2}HJ$
$= \frac{1}{2}(4x) = 2x$
$HJ + JK = HK$
$4x + 2x = 78$
$6x = 78$
$x = 13$
$JK = 2x$
$= 2(13) = 26$

41. 

42. Race distance is:
$13 + 9(8.5) + x = 100$
$89.5 + x = 100$
$x = 10.5 \text{ m}$

43. Race distance is:
$13.72 + 9(9.14) + x = 110$
$95.98 + x = 110$
$x = 14.02 \text{ m}$

44. JK cannot be equal to JL because $JK + KL = JL$ and $KL \neq 0$.

SPIRAL REVIEW

45. $|20 - 8| = |12| = 12$ **46.** $|-9 + 23| = |14| = 14$

47. $-|4 - 27| = -|-23| = -23$

48. $8a - 3(4 + a) - 10$
$= 8a - 12 - 3a - 10$
$= 5a - 22$

49. $x + 2(5 - 2x) - (4 + 5x)$
$= x + 10 - 4x - 4 - 5x$
$= -8x + 6$

50. $\overleftrightarrow{AB}$, $\overleftrightarrow{CB}$ **51.** $\overline{AD}$, $\overline{BD}$

52. A, B, D **53.** $\overrightarrow{CB}$

1-3 MEASURING AND CONSTRUCTING ANGLES, PAGES 20–27

CHECK IT OUT!

1. $\angle RTQ$, $\angle T$, $\angle STR$, $\angle 1$, $\angle 2$

2a. $m\angle BOA = 40°$
$\angle BOA$ is acute.

b. $m\angle DOB = |165° - 40°|$
$= 125°$
$\angle DOB$ is obtuse.

c. $m\angle EOC = 105°$
$\angle EOC$ is obtuse.

3. $m\angle XWZ = m\angle XWY + m\angle YWZ$
$121° = 59° + m\angle YWZ$
$62° = m\angle YWZ$

4a. Step 1 Find y.
$m\angle PQS = \frac{1}{2} m\angle PQR$
$(5y - 1)° = \frac{1}{2}(8y + 12)°$
$5y - 1 = 4y + 6$
$y - 1 = 6$
$y = 7$

Step 2 Find $m\angle PQS$.
$m\angle PQS = 5y - 1$
$= 5(7) - 1$
$= 34°$

b. Step 1 Find x.
$m\angle LJK = m\angle KJM$
$(-10x + 3)° = (-x + 21)°$
$3 = 9x + 21$
$-18 = 9x$
$x = -2$

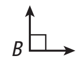
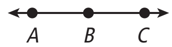
Step 2 Find $m\angle LJM$.
$m\angle LJM = 2m\angle LJK$
$= 2(-10x + 3)$
$= 2\big(-10(-2) + 3\big)$
$= 46°$

THINK AND DISCUSS

1. Two $\angle$s with the same measure are $\cong$. All rt. $\angle$s measure 90°, so any 2 rt. $\angle$s are $\cong$.

2. $m\angle ABD = m\angle DBC = \frac{1}{2} m\angle ABC$

3.

Angle	Measure	Diagram	Name
Acute	Greater than 0° and less than 90°		$\angle A$
Right	90°		$\angle B$
Obtuse	Greater than 90° and less than 180°		$\angle C$
Straight	180°		$\angle ABC$

EXERCISES

GUIDED PRACTICE

1. $\angle A$, $\angle R$, $\angle O$ **2.** C; $\overrightarrow{CB}$, $\overrightarrow{CD}$

3. $\angle AOB$, $\angle BOA$, or $\angle 1$; $\angle BOC$, $\angle COB$, or $\angle 2$; $\angle AOC$ or $\angle COA$

4. $m\angle VXW = 15°$
$\angle VXW$ is acute.

5. $m\angle TXW = 105°$
$\angle TXW$ is obtuse.

6. $m\angle RXU = 110°$
$\angle RXU$ is obtuse.

7. $m\angle JKM = m\angle JKL + m\angle LKM$
$= 42° + 28° = 70°$

8. $m\angle JKM = m\angle JKL + m\angle LKM$
$82.5° = 56.4° + m\angle LKM$
$m\angle LKM = 26.1°$

9. Step 1 Find x.
$m\angle ABD = m\angle DBC$
$(6x + 4)° = (8x - 4)°$
$4 = 2x - 4$
$8 = 2x$
$x = 4$

Step 2 Find $m\angle ABD$.
$m\angle ABD = 6x + 4$
$= 6(4) + 4$
$= 28°$

10. Step 1 Find y.
$m\angle ABD = m\angle DBC$
$(5y - 3)° = (3y + 15)°$
$2y - 3 = 15$
$2y = 18$
$y = 9$

Step 2 Find $m\angle ABC$.
$m\angle ABC = 2m\angle ABD$
$= 2(5y - 3)$
$= 2\big(5(9) - 3\big)$
$= 84°$

PRACTICE AND PROBLEM SOLVING

11. $\angle 1$ or $\angle JMK$; $\angle 2$ or $\angle LMK$; $\angle M$ or $\angle JML$

12. $m\angle CGE = |110 - 20| = 90°$
$\angle CGE$ is a rt. $\angle$.

13. $m\angle BGD = |113 - 20| = 93°$
$\angle BGD$ is obtuse.

14. $m\angle AGB = 20°$
$\angle AGB$ is acute.

15. $m\angle RSU = m\angle RST + m\angle TSU$
$= 38° + 28.6° = 66.6°$

16. $m\angle RSU = m\angle RST + m\angle TSU$
$83.5° = m\angle RST + 46.7°$
$m\angle RST = 36.8°$

17. **Step 1** Find x.
$m\angle RSP = m\angle PST$
$(3x - 2)° = (9x - 26)°$
$-2 = 6x - 26$
$24 = 6x$
$x = 4$

Step 2 Find $m\angle RST$.
$m\angle RST = 2m\angle RSP$
$= 2(3x - 2)$
$= 2(3(4) - 2)$
$= 20°$

18. **Step 1** Find y.
$m\angle PST = \frac{1}{2}m\angle RST$
$(y + 5)° = \frac{1}{2}\left(\frac{5}{2}y\right)°$
$y + 5 = \frac{5}{4}y$
$5 = \frac{1}{4}y$
$y = 20$

Step 2 Find $m\angle RSP$.
$m\angle RSP = m\angle PST$
$= y + 5$
$= 20 + 5$
$= 25°$

19. acute

20. rt.

21. acute

22. obtuse

23–26. Check students' drawings.

27. Let x be the measure of $\angle BSC$.
$m\angle ASB + m\angle BSC = m\angle ASC$
$3x + x = 90$
$4x = 90$
$\frac{4x}{4} = \frac{90}{4}$
$x = 22.5$
$m\angle ASB = 3x = 3(22.5) = 67.5°$
$m\angle BSC = x = 22.5°$

28. First construct the bisector of the given ∠. Then choose one of the smaller ⦣ that was constructed and construct its bisector. The resulting ⦣ will have $\frac{1}{4}$ the measure of the original ∠.

29. $m\angle AOC + m\angle DOC + m\angle EOD = 180°$
$7x - 2 + 2x + 8 + 27 = 180$
$9x + 33 = 180$
$9x = 147$
$x = \frac{147}{9} = 16\frac{1}{3}$

30. $m\angle AOB + m\angle BOC + m\angle COD + m\angle DOE = 180°$
$4x - 2 + 5x + 10 + 3x - 8 + 5x + 10 = 180$
$17x + 10 = 180$
$17x = 170$
$x = 10$

31. $m\angle AOB + m\angle BOC = m\angle AOC$
$6x + 5 + 4x - 2 = 8x + 21$
$10x + 3 = 8x + 21$
$2x + 3 = 21$
$2x = 18$
$x = 9$

32. Let $m\angle QRS = x$. Then $m\angle PRQ = 4x$.
Step 1 Find x.
$m\angle PRQ + m\angle QRS = m\angle PRS$
$4x + x = 90$
$5x = 90$
$x = 18$
$m\angle PRQ = 4(m\angle QRS) = 4(18) = 72°$

33a. $m\angle LOK = 57°$
$3x + 2x + 12 = 57$
$5x + 12 = 57$
$5x = 45$
$x = 9$

b. $\angle LOJ \cong \angle JOK$
$m\angle LOJ = m\angle JOK$
$3x = 2x + 12$
$x = 12$

c. Think: $m\angle LOJ = 3x° > 0°$; so $x > 0$.
$m\angle LOK < 90°$
$5x + 12 < 90$
$5x < 78$
$x < 15.6$
$0 < x < 15.6$

34. $m\angle AOB = (360) \cdot 0.25 = 90°$; rt.
$m\angle BOC = (360) \cdot 0.35 = 126°$; obtuse
$m\angle COD = (360) \cdot 0.10 = 36°$; acute
$m\angle DOA = (360) \cdot 0.30 = 108°$; obtuse

35. $m\angle COD = 2(36) = 72°$
$m\angle BOC = 126 - 36 = 90°$

36. $m\angle = \frac{360}{5} = 72°$

37. No; an obtuse ∠ measures greater than 90°, so it cannot be ≅ to an acute ∠ (less than 90°).

38. $5x + 45 < 180$
$5x < 135$
$x < 27$

39. $m\angle EFG = m\angle EFH + m\angle HFG = 2m\angle EFH$, so $m\angle EFH = \frac{1}{2}m\angle EFG$.

40. Check students' constructions. Each ∠ should measure 35°.

TEST PREP

41. D
$m\angle VOY = m\angle VOW + m\angle WOX + m\angle XOY$
$= \frac{1}{2}m\angle UOW + m\angle WOX + m\angle XOY$
$= \frac{1}{2}(50) + 90 + 40$
$= 155°$

42. H
$m\angle UOX = m\angle UOW + m\angle WOX$
$= 50 + 90$
$= 140°$

43. C
$m\angle ABC = m\angle ABD + m\angle DBC = 2m\angle ABD$
$4x + 5 = 2(3x - 1)$
$4x + 5 = 6x - 2$
$5 = 2x - 2$
$7 = 2x$
$x = 3.5$

44. J
$\frac{1}{2}m\angle + 30 = 90$
$\frac{1}{2}m\angle = 60$
$2\left(\frac{1}{2}m\angle\right) = 2(60)$
$m\angle = 120°$

45. The ⦣ are acute. An obtuse ∠ measures between 90° and 180°. Since $\frac{1}{2}$ of 180 is 90, the resulting ⦣ must measure less than 90°.

CHALLENGE AND EXTEND

46. Each hour interval measures $360 \div 12 = 30°$. The angle formed at 7:00 is the (lesser) angle between the 12 and the 7, which measures $5(30) = 150°$.

47.
$$\begin{aligned} m\angle PQR &= 2m\angle PQS \\ x^2 &= 2(2x + 6) \\ x^2 &= 4x + 12 \\ x^2 - 4x - 12 &= 0 \\ (x - 6)(x + 2) &= 0 \end{aligned}$$
$x - 6 = 0$ or $x + 2 = 0$
$x = 6$ or $x = -2$
$m\angle PQR = x^2 = 36°$ or $4°$

48. $81°24'15'' - 42°30'10''$
$= (81 - 42)° + (24 - 30)' + (15 - 10)''$
$= (80 - 42)° + (60 + 24 - 30)' + (15 - 10)''$
$= 38°54'5''$

49. $2.25° = (60 \cdot 60 \cdot 2.25)'' = 8100$

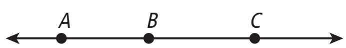
50.
$$\begin{aligned} \angle ABC &\cong \angle DBC \\ m\angle ABC &= m\angle DBC \\ \frac{3x}{2} + 4 &= 2x - 27\frac{1}{4} \\ 31.25 &= \frac{1}{2}x \\ 2(31.25) &= 2\left(\frac{1}{2}x\right) \\ x &= 62.5 \end{aligned}$$
No; $x = 62.5$, and substituting this value into the expressions for the $\angle$ measures gives a sum of 195.5.

SPIRAL REVIEW

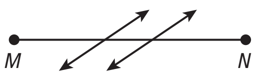
51. $35 \cdot 64\% = 35 \cdot 0.64 = 22.4$

52. $\frac{33.6}{280} \cdot 100\% = 12\%$

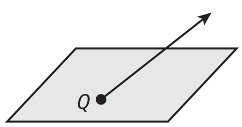
53.



54.



55.



56.
$$\begin{aligned} JK + KL &= JL \\ x + 3x &= 2x + 4 \\ 2x &= 4 \\ x &= 2 \\ JK = x &= 2 \end{aligned}$$

57. $KL = 3x$
$= 3(2)$
$= 6$

58. $JL = 2x + 4$
$= 2(2) + 4$
$= 8$

1-4 PAIRS OF ANGLES, PAGES 28–33

CHECK IT OUT!

1a. $\angle 5$ and $\angle 6$ are adjacent angles. Their noncommon sides, $\overrightarrow{PQ}$ and $\overrightarrow{PT}$, are opposite rays, so $\angle 5$ and $\angle 6$ also form a linear pair.

b. $\angle 7$ and $\angle SPU$ share $\overline{SP}$ but are on the same side of it, so $\angle 7$ and $\angle SPU$ are not adjacent angles.

c. $\angle 7$ and $\angle 8$ share vertex P but do not have a common side, so $\angle 7$ and $\angle 8$ are not adjacent angles.

2a. $(90 - y)°$
$90° - (7x - 12)° = 90° - 7x + 12°$
$= (102 - 7x)°$

b. $(180 - x)°$
$180° - 116.5° = 63.5°$

3. **Step 1** Let $m\angle A = x°$. Then $\angle B$, its supplement, measures $(180 - x)°$.
Step 2 Write and solve an equation.
$$\begin{aligned} x &= \frac{1}{2}(180 - x) + 12 \\ x &= 90 - \frac{x}{2} + 12 \\ x &= 102 - \frac{x}{2} \\ \frac{3}{2}x &= 102 \\ \frac{2}{3}\left(\frac{3}{2}x\right) &= \frac{2}{3}(102) \\ x &= 68 \end{aligned}$$
$m\angle A = x° = 68°$

4. **1 Understand the Problem**
Answers are measures of $\angle 1$, $\angle 2$, and $\angle 4$.
List **important information:**
- $\angle 1 \cong \angle 2$
- $\angle 1$ and $\angle 3$ are comp., and $\angle 2$ and $\angle 4$ are comp.
- $m\angle 3 = 27.6°$

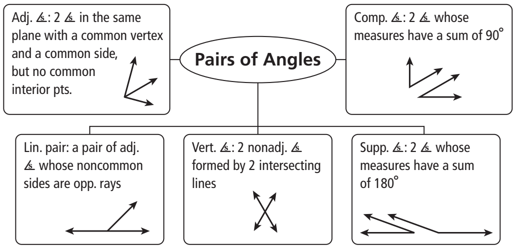
2 Make a Plan
If $\angle 1 \cong \angle 2$, then $m\angle 1 = m\angle 2$.
If $\angle 1$ and $\angle 3$ are comp., then $m\angle 1 = (90 - 27.6)°$.
If $\angle 2$ and $\angle 4$ are comp., then $m\angle 4 = (90 - 27.6)°$.

3 Solve
$m\angle 1 = m\angle 2 = (90 - 27.6)° = 62.4°$
$m\angle 3 = m\angle 4 = (90 - 62.4)° = 27.6°$

4 Look Back
Answer makes sense because $27.6° + 62.4° = 90°$, so $\angle 1$ and $\angle 3$ are comp., and $\angle 2$ and $\angle 4$ are comp. Thus $m\angle 1 = 62.4°$, $m\angle 2 = 62.4°$, and $m\angle 4 = 27.6°$.

5. Possible answer: $\angle EDG$ and $\angle FDH$ are vert. angles and appear to have the same measure.
$\angle EDG \approx \angle FDH \approx 45°$.

THINK AND DISCUSS

1. All rt. ∠s measure 90°, so the sum of the measures of any 2 rt. ∠s is 180°. Therefore any 2 rt. ∠s are supp.
2. Vert. ∠s cannot be adj. ∠s because the def. of vert. ∠s states that they are nonadj. ∠s formed by intersecting lines.
3. 

EXERCISES

GUIDED PRACTICE

1. $(90 - x)°$; $(180 - x)°$ **2.** $\overrightarrow{BC}$
3. ∠1 and ∠2 are adj. angles. Their noncommon sides, $\overrightarrow{EG}$ and $\overrightarrow{EJ}$, are opposite rays, so ∠1 and ∠2 also form a lin. pair.
4. ∠1 and ∠3 share vertex *E* but do not have a common side, so ∠1 and ∠3 are not adj. angles.
5. ∠2 and ∠4 share vertex *E* but do not have a common side, so ∠2 and ∠4 are not adj. angles.
6. ∠2 and ∠3 are adj. angles. Their noncommon sides, $\overrightarrow{EF}$ and $\overrightarrow{EH}$, are not opposite rays, so ∠1 and ∠2 are only adj. angles.
7. $(180 - x)°$
   $180° - 81.2° = 98.8°$

8. $(90 - x)°$
   $90° - 81.2° = 8.8°$

9. $(180 - y)°$
   $180° - (6x - 5)° = 180° - 6x + 5$
   $= (185 - 6x)°$
10. $(90 - y)°$
   $90° - (6x - 5)° = 90° - 6x + 5$
   $= (95 - 6x)°$
11. **Step 1** Let $m\angle A = x°$. Then $\angle B$, its comp., measures $(90 - x)°$.
   Step 2 Write and solve an equation.
   $x = 3(90 - x) + 6$
   $x = 270 - 3x + 6$
   $x = 276 - 3x$
   $4x = 276$
   $x = 69$
   $m\angle A = x = 69°$

12. **1 Understand the Problem**
   Answers are measures of ∠2, ∠3, and ∠4.
   List **Important information:**
   - $\angle 1 \cong \angle 2$
   - ∠1 and ∠3 are comp., and ∠2 and ∠4 are comp.
   - $m\angle 1 = 47.5°$

   2 Make a Plan
   If $\angle 1 \cong \angle 2$, then $m\angle 1 = m\angle 2$.
   If ∠1 and ∠3 are comp., then $m\angle 3 = (90 - 47.5)°$.
   If ∠2 and ∠4 are comp., then $m\angle 4 = (90 - 47.5)°$.

   3 Solve
   $m\angle 1 = m\angle 2 = 47.5°$
   $m\angle 3 = m\angle 4 = (90 - 47.5)° = 42.5°$

   4 Look Back
   Answer makes sense because
   $18.5° + 71.5° = 90°$, so ∠1 and ∠3 are comp., and ∠2 and ∠4 are comp. Thus $m\angle 2 = 18.5°$, $m\angle 3 = 71.5°$, and $m\angle 4 = 71.5°$.
13. ∠*ABE* and ∠*CBD* are vert. ∠s; ∠*ABC* and ∠*EBD* are vert. ∠s.

PRACTICE AND PROBLEM SOLVING, PAGES 32–33

14. ∠1 and ∠4 are adj. angles. Their noncommon sides are opposite rays, so ∠1 and ∠4 also form a lin. pair.
15. ∠2 and ∠3 are adj. angles. Their noncommon sides are opposite rays, so ∠2 and ∠3 also form a lin. pair.
16. ∠3 and ∠4 are adj. angles. Their noncommon sides are not opposite rays, so ∠3 and ∠4 are only adj. angles.
17. ∠3 and ∠1 share a vertex but do not have a common side, so ∠3 and ∠1 are not adj. angles.
18. $(180 - x)°$
   $180° - 56.4° = 123.6°$

19. $(90 - x)°$
   $90° - 56.4° = 33.6°$

20. $(180 - y)°$
   $180° - (2x - 4)° = 180° - 2x + 4$
   $= (184 - 2x)°$
21. $(90 - y)°$
   $90° - (2x - 4)° = 90° - 2x + 4$
   $= (94 - 2x)°$
22. **Step 1** Let $m\angle A = x°$, so $m\angle B = (90 - x)°$.
   Step 2 Write and solve an equation.
   $x = 3(90 - x)$
   $x = 270 - 3x$
   $4x = 270$
   $x = 67.5$
   $m\angle A = x = 67.5°$
   $m\angle B = 90 - 67.5° = 22.5°$
23. $\angle 1 \cong \angle 2$
   $m\angle 1 = m\angle 2 = 22.3°$
   $m\angle 4 = m\angle 3 = 90° - 22.3° = 67.7°$
24. ∠*PTU*, ∠*VTR*; ∠*UTQ*, ∠*STV*; ∠*QTR*, ∠*PTS*; ∠*PTQ*, ∠*STR*; ∠*UTR*, ∠*PTV*; ∠*QTV*, ∠*UTS*

25. Possible outcomes are (30°, 60°), (30°, 120°), (30°, 150°), (60°, 120°), (60°, 150°), (120°, 150°). Supp. outcomes are (30°, 150°) and (60°, 120°). So P(supp.) $= \frac{2}{6} = \frac{1}{3}$

26. **Step 1** Find x.
$m\angle ABD + m\angle BDE = 180°$
$5x + 17x - 18 = 180$
$22x - 18 = 180$
$22x = 198$
$x = 9$
Step 2 Find $\angle$ measures.
$m\angle ABD = 5x = 5(9) = 45°$
$m\angle BDE = 17x - 18 = 17(9) - 18 = 135°$

27. **Step 1** Find x.
$m\angle ABD + m\angle BDE = 180°$
$3x + 12 + 7x - 32 = 180$
$10x - 20 = 180$
$10x = 200$
$x = 20$
Step 2 Find $\angle$ measures.
$m\angle ABD = 3x + 12 = 3(20) + 12 = 72°$
$m\angle BDE = 7x - 32 = 7(20) - 32 = 108°$

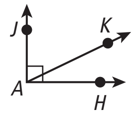
28. **Step 1** Find x.
$m\angle ABD + m\angle BDE = 180°$
$12x - 12 + 3x + 48 = 180$
$15x + 36 = 180$
$15x = 144$
$x = 9.6$
Step 2 Find $\angle$ measures.
$m\angle ABD = 12x - 12 = 12(9.6) - 12 = 103.2°$
$m\angle BDE = 3x + 48 = 3(9.6) + 48 = 76.8°$

29. **Step 1** Find y.
$m\angle ABD + m\angle BDC = 90°$
$5y + 1 + 3y - 7 = 90$
$10y - 6 = 90$
$8y = 96$
$y = 12$
Step 2 Find $\angle$ measures.
$m\angle ABD = 5y + 1 = 5(12) + 1 = 61°$
$m\angle BDC = 3y - 7 = 3(12) - 7 = 29°$

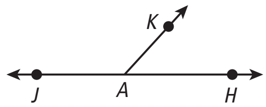
30. **Step 1** Find y.
$m\angle ABD + m\angle BDC = 90°$
$4y + 5 + 4y + 8 = 90$
$8y + 13 = 90$
$8y = 77$
$y = 9.625$
Step 2 Find $\angle$ measures.
$m\angle ABD = 4y + 5 = 4(9.625) + 5 = 43.5°$
$m\angle BDC = 4y + 8 = 4(9.625) + 8 = 46.5°$

31. **Step 1** Find y.
$m\angle ABD + m\angle BDC = 90°$
$y - 30 + 2y = 90$
$3y - 30 = 90$
$3y = 120$
$y = 40$
Step 2 Find $\angle$ measures.
$m\angle ABD = y - 30 = 40 - 30 = 10°$
$m\angle BDC = 2y = 2(40) = 80°$

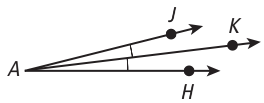
32. The measure of an acute $\angle$ is less than 90°. Therefore the measure of its supp. must be between 90° and 180°, which means the supp. is an obtuse $\angle$.

33a.


Step 1 Find x.
$m\angle JAH + m\angle KAH = 90°$
$3x - 8 + x + 2 = 90$
$4x - 6 = 90$
$4x = 96$
$x = 24$
Step 2 Find $\angle$ measures.
$m\angle JAH = 3x - 8 = 3(24) - 8 = 64°$
$m\angle KAH = x + 2 = 24 + 2 = 26°$

b.


Step 1 Find x.
$m\angle JAH + m\angle KAH = 180°$
$3x - 8 + x + 2 = 180$
$4x - 6 = 180$
$4x = 186$
$x = 46.5$
Step 2 Find $\angle$ measures.
$m\angle JAH = 3x - 8 = 3(46.5) - 8 = 131.5°$
$m\angle KAH = x + 2 = 46.5 + 2 = 48.5°$

c.


Step 1 Find x.
$m\angle JAH = m\angle KAH$
$3x - 8 = x + 2$
$2x = 10$
$x = 5$
Step 2 Find $\angle$ measures.
$m\angle JAH = 3x - 8 = 3(5) - 8 = 7°$
$m\angle KAH = x + 2 = 5 + 2 = 7°$

34. F; the supp. must be greater than the comp.

35. F; vert. $\angle$s cannot be adj. $\angle$s, so they cannot form a lin. pair.

36. T

37. T

38. The 2 $\angle$s must both measure 45°. 45° + 45° = 90°, so the $\angle$s are comp. and $\cong$.

TEST PREP

39. C
$x + 90 + x = 180$
$2x + 90 = 180$
$2x = 90$
$x = 45$

40. H
$x + 2x = 90$
$3x = 90$
$x = 30$
$m\angle 2 = 2(30) = 60°$

41. C

$m\angle A + m\angle B = 180°$
$3y + 2(3y) = 180$
$9y = 180$
$\frac{9y}{9} = \frac{180}{9}$
$y = 20$

42. H

$7x + 5x = 180$
$12x = 180$
$\frac{12x}{12} = \frac{180}{12}$
$x = 15$
$m\angle 2 = 5(15) = 75$

CHALLENGE AND EXTEND

43. 4 pairs of 45° $\measuredangle$s + 4 pairs of 90° $\measuredangle$s + 4 pairs of 135° $\measuredangle$s = 12 pairs of vert. $\measuredangle$s

44. Let $\angle$ measure be $x°$. Then
$180 - x = 2(90 - x) + 4$
$180 - x = 180 - 2x + 4$
$180 - x = 184 - 2x$
$x = 4$
$m\angle = x = 4°$

45. $m\angle 1 + m\angle 2 = 90°$
$2m\angle 2 + m\angle 2 = 90°$
$3m\angle 2 = 90°$
$m\angle 2 = 30°$
$m\angle 1 - m\angle 2 = 2m\angle 2 - m\angle 2$
$= m\angle 2 = 30°$

46. Let $\angle$ measure be $x°$. Then
$180 - x = 2\big(180 - (90 - x)\big) - 36$
$180 - x = 2(180 - 90 + x) - 36$
$180 - x = 144 + 2x$
$36 = 3x$
$x = 12$
$(180 - x)°$
$180° - 12° = 168°$

SPIRAL REVIEW

47. $4x + 10 = 42$
$4x = 32$
$x = 8$

48. $5m - 9 = m + 4$
$4m - 9 = 4$
$4m = 13$
$m = 3.25$

49. $2(y + 3) = 12$
$2y + 6 = 12$
$2y = 6$
$y = 3$

50. $-(d + 4) = 18$
$-d - 4 = 18$
$-d = 22$
$d = -22$

51. $XY + YZ = XZ$
$3x + 1 + 2x - 2 = 84$
$5x - 1 = 84$
$5x = 85$
$x = 17$

52. $XY = 3x + 1$
$= 3(17) + 1 = 52$

53. $YZ = 2x - 2$
$= 2(17) - 2 = 32$

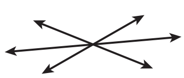
54. $m\angle XYZ = m\angle WYX$
$= 26°$

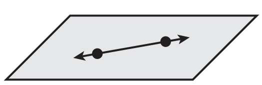
55. $m\angle WYZ = m\angle WYX + m\angle XYZ$
$= 26° + 26° = 52°$

READY TO GO ON? PAGE 35

1. 

2. 

3. 

4. 

5. Possible answer: T, V, W

6. $\overleftrightarrow{XZ}$ and $\overleftrightarrow{WY}$

7. plane TVX

8. ℓ

9. $\overline{SV} = |5 - (-1.5)| = |6.5| = 6.5$

10. $\overline{TR} = |2 - (-4)| = |6| = 6$

11. $\overline{ST} = |2 - (-1.5)| = |3.5| = 3.5$

12. $HJ + JK = HK$
$4x + 6 + 9 = 39$
$4x + 15 = 39$
$4x = 24$
$x = 6$
$HJ = 4x + 6$
$= 4(6) + 6 = 30$

13. Check students' work.

14. $PR = 2PQ$
$8z - 12 = 2(2z)$
$8z - 12 = 4z$
$-12 = -4z$
$z = 3$
$PQ = 2z = 2(3) = 6$
$PR = 8z - 12$
$= 8(3) - 12 = 12$

15. $\angle LMN$, $\angle NML$, or $\angle 1$; $\angle NMP$, $\angle PMN$, or $\angle 2$; $\angle LMP$ or $\angle PML$

16. acute

17. obtuse

18. obtuse

19. $m\angle QRS = m\angle SRT$
$3x + 8 = 9x - 4$
$12 = 6x$
$x = 2$
$m\angle SRT = 9x - 4$
$= 9(2) - 4 = 14°$

20. Check students' work.

21. $\angle 1$ and $\angle 2$ are adj. angles. Their noncommon sides are opposite rays, so $\angle 1$ and $\angle 2$ also form a lin. pair.

22. $\angle 4$ and $\angle 5$ are adj. angles. Their noncommon sides are not opposite rays, so $\angle 4$ and $\angle 5$ are only adj. $\measuredangle$s.

23. $\angle 3$ and $\angle 4$ share a vertex but do not have a common side, so $\angle 3$ and $\angle 4$ are not adj. angles.

24. $(180 - y)°$
$180° - (5x - 10)° = 180° - 5x + 10$
$= (190 - 5x)°$

25. $(90 - y)°$
$90° - (5x - 10)° = 90° - 5x + 10$
$= (100 - 5x)°$

1-5 USING FORMULAS IN GEOMETRY, PAGES 36–41

CHECK IT OUT!

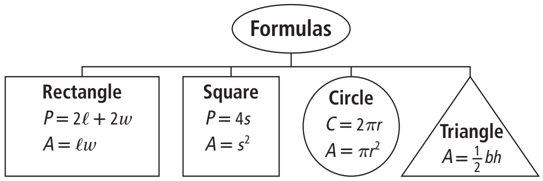
1. $P = 4s$
$= 4(3.5) = 14$ in.

$A = s^2$
$= (3.5)^2 = 12.25 \text{ in}^2$

2. The area of one rectangle is
$A = \ell w = (6.5)(2.5) = 16.25 \text{ in}^2$.
The total area of the 4 rectangles is
$4(16.25) = 65 \text{ in}^2$.

3. $C = 2\pi r$ | $A = \pi r^2$
$= 2\pi(14) = 28\pi$ | $= \pi(14)^2 = 196\pi$
≈ 88.0 m | ≈ 615.8 m^2

THINK AND DISCUSS

1. Possible answer: A rect. with length 8 in. and width 2 in.; a square with sides 4 in. long; a $\triangle$ with base 4 in. and height 8 in.
2. 

EXERCISES

GUIDED PRACTICE

1. Both terms refer to the dist. around a figure.
2. base and height
3. $P = 2\ell + 2w = 2(11) + 2(4) = 22 + 8 = 30$ mm | $A = \ell w = (11)(4) = 44$ mm^2
4. $P = 4s = 4(y - 3) = 4y - 12$ | $A = s^2 = (y - 3)^2 = y^2 - 6y + 9$
5. $P = a + b + c = 5 + (x + 3) + 13 = (x + 21)$ m | $A = \frac{1}{2}bh = \frac{1}{2}(x + 3)(4) = (2x + 6)$ m^2
6. Area of one $\triangle$ is $A = \frac{1}{2}bh = \frac{1}{2}(3)(4) = 6$ in^2.

   There are $80(20) = 1600$ $\triangle$ in total. The total area of the 1600 $\triangle$ is $1600(6) = 9600$ in^2.
7. $C = 2\pi r = 2\pi(2.1) = 4.2\pi \approx 13.2$ m | $A = \pi r^2 = \pi(2.1)^2 = 4.41\pi \approx 13.9$ m^2
8. $C = 2\pi r = 2\pi(7) = 14\pi \approx 44.0$ in. | $A = \pi r^2 = \pi(7)^2 = 49\pi \approx 153.9$ in^2
9. $r = \frac{d}{2} = \frac{16}{2} = 8$ cm
   $C = 2\pi r = 2\pi(8) = 16\pi \approx 50.3$ cm | $A = \pi r^2 = \pi(8)^2 = 64\pi \approx 201.1$ cm^2

PRACTICE AND PROBLEM SOLVING

10. $P = 4s = 4(7.4) = 29.6$ m | $A = s^2 = (7.4)^2 = 54.76$ m^2
11. $P = 2\ell + 2w = 2(x + 6) + 2x = 4x + 12$ | $A = \ell w = (x + 6)x = x^2 + 6x$
12. $P = a + b + c = 5x + 8 + 4x = 9x + 8$ | $A = \frac{1}{2}bh = \frac{1}{2}(8)(3x) = 12x$
13. Area of one $\triangle$ is $\frac{1}{2}bh = \frac{1}{2}(3)(1.5) = 2.25$ in^2.
    Area of 32 $\triangle$ is $32(2.25) = 72$ in^2.
14. $C = 2\pi r = 2\pi(12) = 24\pi \approx 75.4$ m | $A = \pi r^2 = \pi(12)^2 = 144\pi \approx 452.4$ m^2
15. $r = \frac{d}{2} = 6.25$ ft
    $C = 2\pi r = 2\pi(6.25) = 12.5\pi \approx 39.3$ ft
    $A = \pi r^2 = \pi(6.25)^2 = 39.0625\pi \approx 122.7$ ft^2
16. $r = \frac{d}{2} = \frac{1}{4}$ mi
    $C = 2\pi r = 2\pi\left(\frac{1}{4}\right) = \frac{1}{4}\pi \approx 1.6$ mi | $A = \pi r^2 = \pi\left(\frac{1}{4}\right)^2 = \frac{1}{16}\pi \approx 0.2$ mi^2
17. $A = s^2 = (9.1)^2 = 82.81$ yd^2
18. $A = s^2 = (x + 1)^2 = x^2 + 2x + 1$
19. $A = \frac{1}{2}bh = \frac{1}{2}(5.5)(2.25) = 6.1875$ in^2
20. $A = \frac{1}{2}bh$
    $6.75 = \frac{1}{2}(3)h$
    $6.75 = \frac{3}{2}h$
    $\frac{2}{3}(6.75) = \frac{2}{3}\left(\frac{3}{2}h\right)$
    $h = 4.5$ m
21. $A = \ell w$
    $347.13 = 20.3w$
    $w = 17.1$ cm
22. Possible answer:
    $A = \pi r^2$
    $64\pi = \pi r^2$
    $64 = r^2$
    $r = \sqrt{64} = 8$
23. $A = \pi(8)^2$ is incorrect. The radius is 4 cm, not 8 cm. $A = \pi r^2 = \pi(4)^2 = 16\pi$ cm^2
24. $r = \frac{d}{2} = 14$ m
    $A = \pi r^2 = \pi(14)^2 = 196\pi$ m^2
25. $A = \pi r^2 = \pi(3y)^2 = 9y^2\pi$
26. Dist. around Earth at equator is the circumference.
    $C = 2\pi r = 2\pi(3964) = 7928\pi \approx 24{,}907$ mi
27. For a square, the length and width are both s, so $P = 2\ell + 2w = 2s + 2s = 4s$ and $A = \ell w = s(s) = s^2$.
28. $P = 2\ell + 2w = 2(x + 1) + 2(x - 3) = 4x - 4$ | $A = \ell w = (x + 1)(x - 3) = x^2 - 2x - 3$

29. **Step 1** Write two equations.

$h = b - 3; \quad A = \frac{1}{2}bh = 19b$

Step 2 Find h.

$\frac{1}{2}bh = 19b$

$\frac{1}{2}h = 19$

$h = 38$ in.

Step 3 Find b.

$h = b - 3$

$38 = b - 3$

$b = 41$ in.

30a. $P = \pi(4) + 2(3) + 2\sqrt{3^2 + 4^2} \approx 28.6$ ft $= 343.2$ in.
number of strips = 342.2 in. ÷ 24 in. = 14.3
someone cannot buy part of a strip, therefore
cost of material = (15)($1.39) = $20.85

b. charge for labor = total cost − material cost
= $120.30 − $20.85 = $99.45

c. $A = \frac{1}{2}\pi r^2$
$= \frac{1}{2}\pi(4)^2 = 8\pi$
≈ 25.1 ft^2

d. $A = \frac{1}{2}bh$
$= \frac{1}{2}(4)(3) = 6$ ft^2

e. Area of garden $\approx 25.1 + 2(6) \approx 37$ ft^2

31a. Areas of small rects. are ac, ad, bc, and bd.
Sum of areas $= ac + ad + bc + bd$.
This must be equal to $(a + b)(c + d)$, because sum of areas of 4 small rects. equals area of large rect.

b. $(a + 1)(c + 1)$
Areas of small rects. are ac, a, c, and 1.
Sum of areas $= ac + a + c + 1$.
This must be equal to $(a + 1)(c + 1)$, because sum of areas of 4 small rects. equals area of large rect.

c. $(a + 1)^2$
Areas of small rects. are a^2, a, a, and 1.
Sum of areas $= a^2 + 2a + 1$.
This must be equal to the product $(a + 1)^2$ because the sum of the areas of the 4 small rects. equals the area of the large rect.

32. max. area − min. area
$= (110)(75) - (100)(64)$
$= 8250 - 6400 = 1850$ m^2

33. $A = \frac{1}{2}bh$

$28 = \frac{1}{2}(2)h$

$h = 28$ ft

34. $A = \frac{1}{2}bh$

$282.5 = \frac{1}{2}(22.6)h$

$282.5 = 11.3h$

$h = 25$ yd

35. $A = bh$
$= (9.8)(2.7) = 26.46$ ft^2

36. $A = bh$
$= \big(4(5280) + 960\big)(440) = 9{,}715{,}200$ ft^2
$= \frac{9{,}715{,}200}{5280^2} = 0.3\overline{48}$ mi^2

37. $A = bh$
$= \big(3(3) + 12\big)(11) = 231$ ft^2
$= \frac{231}{3^2} = 25\frac{2}{3}$ yd^2

38. $P = 2b + 2h$
$= 2(21.4) + 2(7.8) = 58.4$ in.

39. $b = 4$ ft 6 in. $= 4.5$ ft; $h = 6$ in. $= 0.5$ ft
$P = 2b + 2h$
$= 2(4.5) + 2(0.5) = 10$ ft

40. $b = 2$ yd 8 ft $= (2(3) + 8)$ ft $= 14$ ft
$P = 2b + 2h$
$= 2(14) + 2(6) = 40$ ft $= 13$ yd 1 ft

41. $C = 2\pi r$
$14 = 2\pi r$
$\frac{7}{\pi} = r$
$d = 2r = \frac{14}{\pi}$

42. $A = \pi r^2$
$100\pi = \pi r^2$
$100 = r^2$
$10^2 = r^2$
$r = \sqrt{100} = 10$
$d = 2r = 20$

43. $C = 2\pi r$
$50\pi = 2\pi r$
$25 = r$
$d = 2r = 50$

44. Missing outer dimensions:
$17 - 4 = 13$ yd; $9 - 4 = 5$ yd
$P = 17 + 5 + 4 + 4 + 13 + 9 = 52$ yd
A = sum of areas of two rects.
$= (13)(9) + (4)(5) = 137$ yd^2

45. Measure any side as the base. Then measure the ht. of the △ at a rt. ∠ to the base.

46. The method works because adding the length and width together and doubling the result is $2(\ell + w)$, which equals $2\ell + 2w$.

TEST PREP

47. B
$A = \pi r^2$
$452 = \pi r^2$
$\frac{452}{\pi} = r^2$
$r = \sqrt{\frac{452}{\pi}} \approx 12.0$ in.

48. G
$\ell = 2w$
$P = 2\ell + 2w$
$P = 2(2w) + 2w$
$P = 6w$
$48 = 6w$
$w = 8$ m
$\ell = 2w$
$= 2(8) = 16$ m

49. A
$A = \frac{1}{2}bh$
$= \frac{1}{2}(4x)(x + 2)$
$= 2x^2 + 4x$

50. J
$P = 4s$
$= 4(90)$
$= 360$ in. $= 30$ ft

CHALLENGE AND EXTEND

51. $A_{metal} = A_{rect.} - A_{circle}$
$= \ell w - \pi r^2$
$= (14)(8) - \pi(3)^2 = 112 - 9\pi$
≈ 83.7 in^2

52a. $P = 2\ell + 2w$
$P - 2\ell = 2w$
$\frac{P - 2\ell}{2} = w$

b. $w = \frac{P - 2\ell}{2}$
$= \frac{9 - 2(3)}{2} = 1.5$ ft

53. Think: assume that $\ell \geq w$. Values for (ℓ, w) satisfy $12 = 2\ell + 2w$ or $\ell + w = 6$: (5, 1), (4, 2), or (3, 3). So possible areas are
$A = \ell w$
$= (5)(1) = 5$; or $(4)(2) = 8$; or $(3)(3) = 9$

54. $A_{\text{actual}} = \pi r^2$
$= \pi(4.5)^2 = 20.25\pi$
$A_{\text{estimate}} = s^2$
$= 8^2 = 64$
Percent error $= \frac{A_{\text{estimate}} - A_{\text{actual}}}{A_{\text{actual}}} \cdot 100\%$
$= \frac{64 - 20.25\pi}{20.25\pi} \cdot 100\%$
$\approx 0.6\%$ (overestimate)

55. Step 1 Write an equation relating ℓ and w.
$w = \frac{4}{5}\ell$
Step 2 Substitute in formula for area of a rectangle and solve to find ℓ.
$A = \ell w$
$320 = \ell\left(\frac{4}{5}\ell\right)$
$320 = \frac{4}{5}\ell^2$
$\frac{5}{4}(320) = \frac{5}{4}\left(\frac{4}{5}\ell^2\right)$
$400 = \ell^2$
$\sqrt{400} = \ell$
$\ell = 20$ in.
Step 3 Find w.
$w = \frac{4}{5}\ell = \frac{4}{5}(20) = 16$ in.

SPIRAL REVIEW

56. D: {2, −5, −3}
R: {4, 8}

57. D: {4, −2, 16}
R: {−2, 8, 0}

58. plane

59. line or segment

60. Let a and b be the lengths. Write 2 equations.
$a = 4b$
$10 = a + b$
$10 = 4b + b$
$10 = 5b$
$\frac{10}{5} = \frac{5b}{5}$
$b = 2$ yd
$a = 4b = 4(2) = 8$ yd

61. $\overline{AB} \cong \overline{BC}$
$AB = BC$
$|-2.5 - (-8)| = |C - (-2.5)|$
$5.5 = |C - (-2.5)|$
Think: $B > A$, so $C > B$. Therefore
$C - (-2.5) = 5.5$
$C = -2.5 + 5.5 = 3$

62. $m\angle = 2(180 - m\angle) + 9$
$m\angle = 360 - 2m\angle + 9$
$3m\angle = 369$
$m\angle = 123°$

1-6 MIDPOINT AND DISTANCE IN THE COORDINATE PLANE, PAGES 43–49

CHECK IT OUT!

1. $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
$\left(\frac{-2 + 5}{2}, \frac{3 + (-3)}{2}\right) = \left(\frac{3}{2}, \frac{0}{2}\right)$
$= \left(\frac{3}{2}, 0\right)$

2. Step 1 Let coords. of T equal (x, y).
Step 2 Use Mdpt. Formula.
$(-1, 1) = \left(\frac{-6 + x}{2}, \frac{-1 + y}{2}\right)$
Step 3 Find x-coord.
$-1 = \frac{-6 + x}{2}$
$2(-1) = 2\left(\frac{-6 + x}{2}\right)$
$-2 = -6 + x$
$x = 4$
Find y-coord.
$1 = \frac{-1 + y}{2}$
$2(1) = 2\left(\frac{-1 + y}{2}\right)$
$2 = -1 + y$
$y = 3$
The coordinates of T are (4, 3).

3. Step 1 Find coords. of each point.
$E(-2, 1)$, $F(-5, 5)$, $G(-1, -2)$, and $H(3, 1)$
Step 2 Use Dist. Formula.
$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$EF = \sqrt{(-5 - (-2))^2 + (5 - 1)^2}$
$= \sqrt{(-3)^2 + 4^2}$
$= \sqrt{9 + 16} = 5$
$GH = \sqrt{(3 - (-1))^2 + (1 - (-2))^2}$
$= \sqrt{4^2 + 3^2}$
$= \sqrt{16 + 9} = 5$
Since $EF = GH$, $\overline{EF} \cong \overline{GH}$.

4a. Method 1 Use Dist. Formula. Subst. values for coords. of R and S into Dist. Formula.
$RS = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(-3 - 3)^2 + (-1 - 2)^2}$
$= \sqrt{(-6)^2 + (-3)^2}$
$= \sqrt{36 + 9} = \sqrt{45} \approx 6.7$
Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by R and S.
$a = 6$ and $b = 3$
$c^2 = a^2 + b^2$
$= 6^2 + 3^2$
$= 36 + 9$
$= 45$
$c = \sqrt{45} \approx 6.7$

b. Method 1 Use Dist. Formula. Subst. values for coords. of R and S into Dist. Formula.

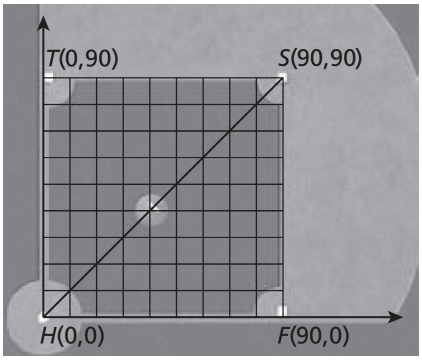
$$RS = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(2 - (-4))^2 + (-1 - 5)^2}$$
$$= \sqrt{(-6)^2 + (-6)^2}$$
$$= \sqrt{36 + 36} = \sqrt{72} \approx 8.5$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by R and S.

$a = 6$ and $b = 6$

$$c^2 = a^2 + b^2$$
$$= 6^2 + 3^2$$
$$= 36 + 36$$
$$= 72$$
$$c = \sqrt{72} \approx 8.5$$

5.



Let the pitching mound be $M(42.8, 42.8)$. The dist. MH from center of mound to home plate is the length of hyp. of a rt. △.

$$MH = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(42.8 - 0)^2 + (42.8 - 0)^2}$$
$$= \sqrt{42.8^2 + 42.8^2}$$
$$= \sqrt{1831.84 + 1831.84}$$
$$= \sqrt{3663.68} \approx 60.5 \text{ ft}$$

THINK AND DISCUSS

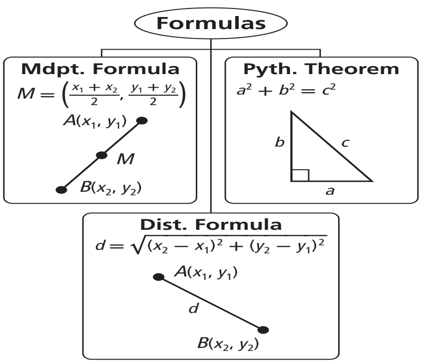
1. yes; $\dfrac{x_1 + x_2}{2} = \dfrac{x_2 + x_1}{2}$ and $\dfrac{y_1 + y_2}{2} = \dfrac{y_2 + y_1}{2}$

2. s and t represent lengths of legs. r represents length of hyp.

3. Yes; you can use either method to find dist. between 2 pts.

4. Possible answer: to make locating addresses easier

5.



EXERCISES

GUIDED PRACTICE

1. hypotenuse

2. $M\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$

$$\left(\frac{4 + (-4)}{2}, \frac{-6 + 2}{2}\right) = \left(\frac{0}{2}, \frac{-4}{2}\right)$$
$$= (0, -2)$$

3. $M\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$

$$\left(\frac{0 + 3}{2}, \frac{-8 + 0}{2}\right) = \left(\frac{3}{2}, \frac{-8}{2}\right)$$
$$= \left(1\frac{1}{2}, -4\right)$$

4. Step 1 Let coords. of N equal (x, y).

Step 2 Use Mdpt. Formula:

$$(0, 1) = \left(\frac{-3 + x}{2}, \frac{-1 + y}{2}\right)$$

Step 3 Find x-coord.

$$0 = \frac{-3 + x}{2}$$
$$2(0) = 2\left(\frac{-3 + x}{2}\right)$$
$$0 = -3 + x$$
$$x = 3$$

Find y-coord.

$$1 = \frac{-1 + y}{2}$$
$$2(1) = 2\left(\frac{-1 + y}{2}\right)$$
$$2 = -1 + y$$
$$y = 3$$

The coordinates of N are (3, 3).

5. Step 1 Let coords. of C equal (x, y).

Step 2 Use Mdpt. Formula.

$$\left(-1\frac{1}{2}, 1\right) = \left(\frac{-3 + x}{2}, \frac{4 + y}{2}\right)$$

Step 3 Find x-coord.

$$-1\frac{1}{2} = \frac{-3 + x}{2}$$
$$2\left(\frac{3}{2}\right) = 2\left(\frac{-3 + x}{2}\right)$$
$$-3 = -3 + x$$
$$x = 0$$

Find y-coord.

$$1 = \frac{4 + y}{2}$$
$$2(1) = 2\left(\frac{4 + y}{2}\right)$$
$$2 = 4 + y$$
$$y = -2$$

The coordinates of C are (0, –2).

6. Step 1 Find coords. of each point.

$F(5, 4)$, $G(3, -1)$, $J(-4, 0)$, and $K(1, -2)$

Step 2 Use Dist. Formula.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$JK = \sqrt{(1 - (-4))^2 + (-2 - 0)^2}$$
$$= \sqrt{5^2 + (-2)^2}$$
$$= \sqrt{25 + 4} = \sqrt{29}$$
$$FG = \sqrt{(3 - 5)^2 + (-1 - 4)^2}$$
$$= \sqrt{(-2)^2 + (-5)^2}$$
$$= \sqrt{4 + 25} = \sqrt{29}$$

Since $JK = FG$, $\overline{JK} \cong \overline{FG}$.

7. **Step 1** Find coords. of each point.
$J(-4, 0)$, $K(1, -2)$, $R(-3, -2)$, and $S(3, -5)$
Step 2 Use Dist. Formula.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$JK = \sqrt{(1 - (-4))^2 + (-2 - 0)^2}$$
$$= \sqrt{5^2 + (-2)^2}$$
$$= \sqrt{25 + 4} = \sqrt{29}$$
$$RS = \sqrt{(3 - (-3))^2 + (-5 - (-2))^2}$$
$$= \sqrt{6^2 + (-3)^2}$$
$$= \sqrt{36 + 9}$$
$$= \sqrt{45} = 3\sqrt{5}$$

Since $JK \neq RS$, $\overline{JK} \ncong \overline{RS}$.

8. **Method 1** Use Dist. Formula. Subst. values for coords. of A and B into Dist. Formula.

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-4 - 1)^2 + (-4 - (-2))^2}$$
$$= \sqrt{(-5)^2 + (-2)^2}$$
$$= \sqrt{25 + 4} = \sqrt{29} \approx 5.4$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by A and B.
$a = 5$ and $b = 2$

$$c^2 = a^2 + b^2$$
$$= 5^2 + 2^2$$
$$= 25 + 4$$
$$= 29$$
$$c = \sqrt{29} \approx 5.4$$

9. **Method 1** Use Dist. Formula. Subst. values for coords. of X and Y into Dist. Formula.

$$XY = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-2 - (-2))^2 + (-8 - 7)^2}$$
$$= \sqrt{(0)^2 + (-15)^2}$$
$$= \sqrt{0 + 225} = 15.0$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by X and Y.
$a = 0$ and $b = 15$

$$c^2 = a^2 + b^2$$
$$= 0^2 + 15^2$$
$$= 225$$
$$c = \sqrt{225} = 15.0$$

10. **Method 1** Use Dist. Formula. Subst. values for coords. of V and W into Dist. Formula.

$$VW = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-4 - 2)^2 + (8 - (-1))^2}$$
$$= \sqrt{(-6)^2 + 9^2}$$
$$= \sqrt{36 + 81} = \sqrt{117} \approx 10.8$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by V and W.
$a = 6$ and $b = 9$

$$c^2 = a^2 + b^2$$
$$= 6^2 + 9^2$$
$$= 36 + 81$$
$$= 117$$
$$c = \sqrt{117} \approx 10.8$$

11. Use Pyth. Thm. From the plan, $a = 22$ and $b = 16$.

$$c^2 = a^2 + b^2$$
$$= 22^2 + 16^2$$
$$= 484 + 256 = 740$$
$$c = \sqrt{740} \approx 27.2 \text{ ft}$$

PRACTICE AND PROBLEM SOLVING

12. $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$$\left(\frac{-3 + (-1)}{2}, \frac{-7 + 1}{2}\right) = \left(\frac{-4}{2}, \frac{-6}{2}\right)$$
$$= (-2, -3)$$

13. $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$$\left(\frac{12 + (-5)}{2}, \frac{-7 + (-2)}{2}\right) = \left(\frac{7}{2}, \frac{-9}{2}\right)$$
$$= \left(3\frac{1}{2}, -4\frac{1}{2}\right)$$

14. **Step 1** Let coords. of R equal (x, y).
Step 2 Use Mdpt. Formula.

$$(7, -9) = \left(\frac{-3 + x}{2}, \frac{5 + y}{2}\right)$$

Step 3 Find x-coord. Find y-coord.

$$7 = \frac{-3 + x}{2} \qquad -9 = \frac{5 + y}{2}$$
$$14 = -3 + x \qquad -18 = 5 + y$$
$$x = 17 \qquad y = -23$$

The coordinates of R are $(17, -23)$.

15. **Step 1** Let coords. of C equal (x, y).
Step 2 Use Mdpt. Formula.

$$\left(2\frac{1}{2}, 1\right) = \left(\frac{x + (-3)}{2}, \frac{y + (-2)}{2}\right)$$

Step 3 Find x-coord. Find y-coord.

$$2\frac{1}{2} = \frac{x + (-3)}{2} \qquad 1 = \frac{y + (-2)}{2}$$
$$5 = x - 3 \qquad 2 = y - 2$$
$$x = 8 \qquad y = 4$$

The coordinates of C are $(8, 4)$.

16. **Step 1** Find coords. of each point.
$D(-4, 0)$, $E(0, -2)$, $F(2, 3)$, and $G(4, -1)$.
Step 2 Use Dist. Formula.

$$DE = \sqrt{(0 - (-4))^2 + (-2 - 0)^2}$$
$$= \sqrt{4^2 + (-2)^2}$$
$$= \sqrt{16 + 4} = \sqrt{20} = 2\sqrt{5}$$
$$FG = \sqrt{(4 - 2)^2 + (-1 - 3)^2}$$
$$= \sqrt{2^2 + (-4)^2}$$
$$= \sqrt{4 + 16} = \sqrt{20} = 2\sqrt{5}$$

Since $DE = FG$, $\overline{DE} \cong \overline{FG}$.

17. **Step 1** Find coords. of each point.
$D(-4, 0)$, $E(0, -2)$, $R(-3, -4)$, and $S(2, -2)$.
Step 2 Use Dist. Formula.

$$DE = \sqrt{(0-(-4))^2 + (-2-0)^2} = \sqrt{4^2 + (-2)^2} = \sqrt{16+4} = \sqrt{20} = 2\sqrt{5}$$

$$RS = \sqrt{(2-(-3))^2 + (-2-(-4))^2} = \sqrt{5^2 + 2^2} = \sqrt{25+4} = \sqrt{29}$$

Since $DE \neq RS$, $\overline{DE} \ncong \overline{RS}$.

18. **Method 1** Dist. Formula.

$$UV = \sqrt{(-3-0)^2 + (-9-1)^2} = \sqrt{(-3)^2 + (-10)^2} = \sqrt{9+100} = \sqrt{109} \approx 10.4$$

Method 2 Pyth. Thm. Count the units for the legs of the rt. $\triangle$ formed by U and V.
$a = 3$ and $b = 10$

$$c^2 = a^2 + b^2 = 3^2 + 10^2 = 100 + 9 = 109$$
$$c = \sqrt{109} \approx 10.4$$

19. **Method 1** Dist. Formula.

$$MN = \sqrt{(2-10)^2 + (-5-(-1))^2} = \sqrt{(-8)^2 + (-4)^2} = \sqrt{64+16} = \sqrt{80} \approx 8.9$$

Method 2 Pyth. Thm. Count the units for the legs of the rt. $\triangle$ formed by M and N.
$a = 8$ and $b = 4$

$$c^2 = a^2 + b^2 = 8^2 + 4^2 = 64 + 16 = 80$$
$$c = \sqrt{80} \approx 8.9$$

20. **Method 1** Dist. Formula.

$$PQ = \sqrt{(5-(-10))^2 + (5-1)^2} = \sqrt{15^2 + 4^2} = \sqrt{225+16} = \sqrt{241} \approx 15.5$$

Method 2 Pyth. Thm. Count the units for the legs of the rt. $\triangle$ formed by P and Q.
$a = 15$ and $b = 4$

$$c^2 = a^2 + b^2 = 15^2 + 4^2 = 225 + 16 = 241$$
$$c = \sqrt{241} \approx 15.5$$

21. Use Pyth. Thm.
$a = 11$ and $b = 14$

$$c^2 = a^2 + b^2 = 11^2 + 14^2 = 121 + 196 = 317$$
$$c = \sqrt{317} \approx 18 \text{ in.}$$

22. **Step 1** Find coords. of each point.
$A(-4, 2)$, $B(1, 4)$, $C(2, 5)$, $D(4, 1)$, $E(-2, -2)$, and $F(3, -1)$.
Step 2 Use Dist. Formula.

$$AB = \sqrt{(1-(-4))^2 + (4-2)^2} = \sqrt{5^2 + 2^2} = \sqrt{25+4} = \sqrt{29}$$

$$CD = \sqrt{(4-2)^2 + (1-5)^2} = \sqrt{2^2 + (-4)^2} = \sqrt{4+16} = \sqrt{20}$$

$$EF = \sqrt{(3-(-2))^2 + (-1-(-2))^2} = \sqrt{5^2 + 1^2} = \sqrt{25+1} = \sqrt{26}$$

$\overline{CD}$, $\overline{EF}$, $\overline{AB}$

23. $a = 2$ and $b = 4$

$$c^2 = 2^2 + 4^2 = 20$$
$$c = \sqrt{20} \approx 4.47$$

24.
$$\left(\frac{a+(-5a)}{2}, \frac{3a+0}{2}\right) = \left(\frac{-4a}{2}, \frac{3a}{2}\right) = \left(-2a, \frac{3}{2}a\right)$$

25. Divide each coord. by 2.

26. Coords. of Cedar City are (2, 3).
Coords. of Milltown are (3, −3).

$$\text{Dist.} = \sqrt{(3-2)^2 + (-3-3)^2} = \sqrt{1^2 + (-6)^2} = \sqrt{37} \approx 6.1 \text{ mi}$$

27. Coords. of Jefferson are (−2, −2).

$$\text{Dist.} = \frac{1}{2}(\text{dist. from Jefferson to Milltown}) = \frac{1}{2}\sqrt{(3-(-2))^2 + (-3-(-2))^2} = \frac{1}{2}\sqrt{5^2 + (-1)^2} = \frac{1}{2}\sqrt{26} \approx 2.5 \text{ mi}$$

28. Use Pyth. Thm.
$a = 960$ and $b = 750$

$$c^2 = a^2 + b^2 = 960^2 + 750^2 = 1{,}484{,}100$$
$$c = \sqrt{1{,}484{,}100} \approx 1218 \text{ m}$$

29. Possible answer: seg. with endpts. (1, 2) and (−1, −2)

30. **Step 1** Find AB, BC, and AC.

$$AB = \sqrt{(-2-1)^2 + (-1-4)^2}$$
$$= \sqrt{(-3)^2 + (-5)^2}$$
$$= \sqrt{9+25} = \sqrt{34}$$
$$BC = \sqrt{(-3-(-2))^2 + (-2-(-1))^2}$$
$$= \sqrt{(-1)^2 + (-1)^2}$$
$$= \sqrt{1+1} = \sqrt{2}$$
$$AC = \sqrt{(-3-1)^2 + (-2-4)^2}$$
$$= \sqrt{(-4)^2 + (-6)^2}$$
$$= \sqrt{16+36} = \sqrt{52}$$

Step 2 Find perimeter.

$$P = AB + BC + AC$$
$$= \sqrt{34} + \sqrt{2} + \sqrt{52} \approx 14.5$$

31. $A = \frac{1}{2}bh$

$$= \frac{1}{2}(BC)(\sqrt{2})$$
$$= \frac{1}{2}(\sqrt{2})(\sqrt{2})$$
$$= \frac{1}{2}(2) = 1 \text{ square unit}$$

32. When 2 pts. lie on a horiz. or vert. line, they share a common y-coord. or x-coord. To find the dist. between the pts., find the difference of the other coords.

33. Let M be the mdpt. of $\overline{AC}$.

$AM = MC = \frac{1}{2}(10) = 5.0$ ft

$MB = MD = \sqrt{5^2 + 4^2} = \sqrt{41} \approx 6.4$ ft

TEST PREP

34. B

$GH = \sqrt{3^2 + 3^2} = \sqrt{18} \approx 4.2$

35. G

Coords. of mdpt. of $\overline{LM}$ are (2.5, 1); coords. of mdpt. of $\overline{JK}$ are (1.5, –2.5).

$$\text{Dist.} = \sqrt{(2.5-1.5)^2 + (1-(-2.5))^2}$$
$$= \sqrt{1^2 + 3.5^2}$$
$$= \sqrt{13.25} \approx 3.6$$

36. D

$$\left(\frac{7+(-5)}{2}, \frac{-3+6}{2}\right) = \left(\frac{2}{2}, \frac{3}{2}\right)$$
$$= \left(1, 1\frac{1}{2}\right)$$

37. J

$$\text{Dist.} = \sqrt{(3-(-5))^2 + (5-1)^2}$$
$$= \sqrt{8^2 + 4^2}$$
$$= \sqrt{80} \approx 8.9$$

CHALLENGE AND EXTEND

38a. x-coord. of Q = x-coord. of $P = \frac{1+4}{2} = 2.5$;

y-coord. of Q = y-coord. of $R = \frac{1+3}{2} = 2$;

coords. of Q are (2.5, 2).

b. Area of $PBRQ = \ell w = (1.5)(1) = 1.5$ square units

c. $DB = \sqrt{3^2 + 2^2} = \sqrt{13} \approx 3.6$

39.
$$XY^2 = (a+1-(a-5))^2 + (2a-(-2a))^2$$
$$10^2 = 6^2 + (4a)^2$$
$$100 - 36 = (4a)^2$$
$$4a = \pm\sqrt{64} = \pm 8$$
$$a = \pm 2$$

40. Let coords. of pt. on y-axis be $(0, y)$.

$$5^2 = (4-0)^2 + (2-y)^2$$
$$25 = 16 + 4 - 4y + y^2$$
$$0 = y^2 - 4y - 5$$
$$0 = (y-5)(y+1)$$
$$y = 5 \text{ or } -1$$

Coords. of 2 pts. are (0, 5) and (0, –1).

41. By Pyth. Thm.,

$$AB^2 = AC^2 + BC^2$$
$$= x^2 + y^2$$
$$AB = \sqrt{x^2 + y^2}$$

SPIRAL REVIEW

42.

y	$3x - 1$	
4	$3(-1) - 1$	
4	-4	X

no

43.

$f(x)$	$5 - x^2$	
4	$5 - (-1)^2$	
4	4	✓

yes

44.

$g(x)$	$x^2 - x + 2$	
4	$(-1)^2 - (-1) + 2$	
4	4	✓

yes

45. $m\angle ABD = \frac{1}{2}(180) = 90°$; rt.

46. $m\angle CBE = \frac{1}{2}m\angle CBD = \frac{1}{2}(180 - 90) = 45°$; acute

47. $m\angle ABE = 180 - m\angle CBE = 135°$; obtuse

48.
$$P = 4s$$
$$20 = 4s$$
$$s = 5 \text{ in.}$$
$$A = s^2$$
$$= 5^2 = 25 \text{ in}^2$$

49.
$$b = 2h$$
$$= 2(2) = 4 \text{ ft}$$
$$A = \frac{1}{2}bh$$
$$= \frac{1}{2}(4)(2) = 4 \text{ ft}^2$$

50.
$$A = \ell w$$
$$= (x)(4x+5)$$
$$= 4x^2 + 5x$$

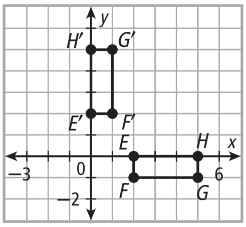
1-7 TRANSFORMATIONS IN THE COORDINATE PLANE, PAGES 50–55

CHECK IT OUT!

1a. The transformation is a translation.
$MNOP \rightarrow M'N'O'P'$

b. The transformation is a 90° rotation.
$\triangle XYZ \rightarrow \triangle X'Y'Z'$

2.

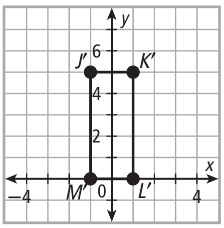


The transformation is a rotation of 90° because each pt. has been rotated 90° counterclockwise about the origin.

3. Step 1 Find the coordinates of rect. *JKLM*.
The vertices of rect. *JKLM* are $J(1, 1)$, $K(3, 1)$, $L(3, -4)$, and $M(1, -4)$.
Step 2 Apply the rule to find the vertices of the image.

$J'(1 - 2, 1 + 4) = J'(-1, 5)$
$K'(3 - 2, 1 + 4) = K'(1, 5)$
$L'(3 - 2, -4 + 4) = L'(1, 0)$
$M'(1 - 2, -4 + 4) = M'(-1, 0)$

Step 3

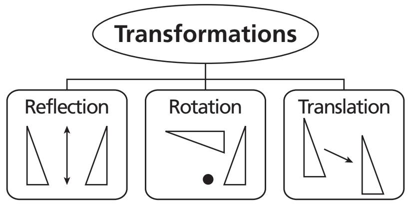


4. Step 1 Choose 2 pts.
Choose a pt. *A* on the preimage and a corr. pt. A'' on the image. *A* has coords. (3, 1) and A'' has coords. (−1, −3).
Step 2 Translate.
To translate *A* to A'', 4 units are subtracted from both the *x*-coord. and the *y*-coord. Therefore, the translation rule is $(x, y) \rightarrow (x - 4, y - 4)$.

THINK AND DISCUSS

1. Possible answer: The preimage and image will be mirror images of each other.

2.



EXERCISES

GUIDED PRACTICE

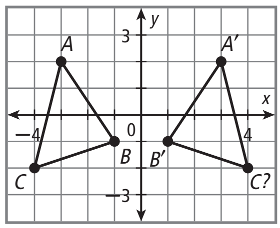
1. Preimage is $\triangle XYZ$; image is $\triangle X'Y'Z'$.

2. translation; reflection; rotation

3. transformation is a reflection; $\triangle ABC \rightarrow \triangle A'B'C'$

4. transformation is a translation; $PQRS \rightarrow P'Q'R'S'$

5.

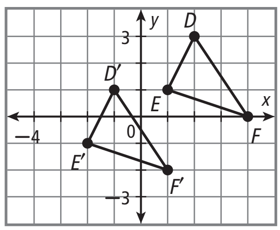


The transformation is a reflection across the *y*-axis because each pt. and its image are the same dist. from the *y*-axis.

6. Step 1 State the coordinates of $\triangle DEF$.
The vertices of $\triangle DEF$ are $D(2, 3)$, $E(1, 1)$, and $F(4, 0)$.
Step 2 Apply the rule to find the vertices of the image.

$D'(2 - 3, 3 - 2) = D'(-1, 1)$
$E'(1 - 3, 1 - 2) = E'(-2, -1)$
$F'(4 - 3, 0 - 2) = F'(1, -2)$

Step 3



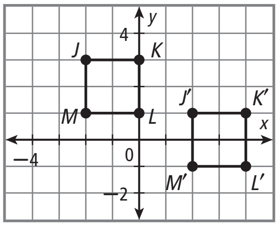
7. Step 1 Choose 2 pts.
Choose a pt. *A* on the preimage and a corr. pt. A' on the image. *A* has coords. (0, 0) and A' has coords. (4, 4).
Step 2 Translate.
To translate *A* to A', 4 units are added to both the *x*-coord. and the *y*-coord. Therefore, the translation rule is $(x, y) \rightarrow (x + 4, y + 4)$.

PRACTICE AND PROBLEM SOLVING

8. rotation: $DEFG \rightarrow D'E'F'G'$

9. reflection: $WXYZ \rightarrow W'X'Y'Z'$

10.

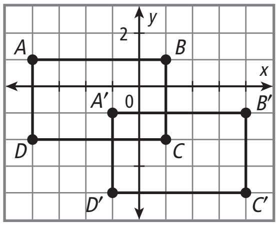


translation; each pt. moves the same dist. right and the same dist. down.

11. **Step 1** Apply the rule to find the vertices of the image.

$A'(-4 + 3, 1 - 2) = A'(-1, -1)$
$B'(1 + 3, 1 - 2) = B'(4, -1)$
$C'(1 + 3, -2 - 2) = C'(4, -4)$
$D'(-4 + 3, -2 - 2) = D'(-1, -4)$

Step 2



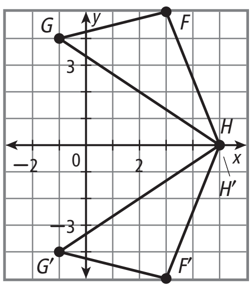
12. **Step 1** Choose 2 pts.
Choose a pt. A on the preimage and a corr. pt. A' on the image. A has coords. $(-5, 1)$ and A' has coords. $(6, -3)$.
Step 2 Translate.
To translate A to A', 11 units are added to the x-coord. and 4 units are subtracted from the y-coord. Therefore, the translation rule is
$(x, y) \rightarrow (x + 11, y - 4)$.

13. reflection

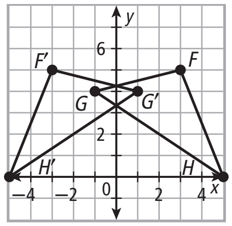
14. translation

15. reflection

16. Vertices of image are $F'(3, -5)$, $G'(-1, -4)$, and $H'(5, 0)$.



17. Vertices of image are $F''(-3, 5)$, $G''(1, 4)$, and $H''(-5, 0)$.



18. Vertices of $\triangle 1$ are (1, 1), (3, 1), and (2, 3).
$\triangle 1$ to $\triangle 2$: $(x, y) \rightarrow (x, -y)$
$\triangle 2$ to $\triangle 3$: $(x, y) \rightarrow (-x, y)$
$\triangle 3$ to $\triangle 4$: $(x, y) \rightarrow (x, -y)$

19. *B*

20. *A*

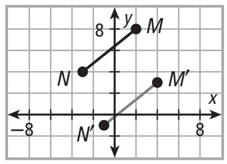
21. *D*

22. *C*

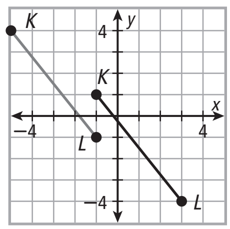
23. $R'(1 - 2, -4 - 8) = R'(-1, -12)$
$S'(-1 - 2, -1 - 8) = S'(-3, -9)$
$T'(-5 - 2, 1 - 8) = T'(-7, -7)$

24. Both translations move the preimage right and up. The second translation moves the preimage farther in each direction.

25. $M'(2 + 2, 8 - 5) = M'(4, 3)$
$N'(-3 + 2, 4 - 5) = N'(-1, -1)$



26. $K'(-1 - 4, 1 + 3) = K'(-5, 4)$
$L'(3 - 4, -4 + 3) = L'(-1, -1)$



27. Find the coords. of the preimage. Then, find the coords. of the image after translation. Plot the vertices of image pts. and use a straightedge to draw the image $\triangle$.

28. Possible answer: 2 reflections (across the y-axis and across $\overleftrightarrow{EC}$)

TEST PREP

29. A

30. H
$E'(-3 - 2, -3 + 1) = E'(-5, -2)$

31. A
$1 + (-3) = -2$ ✓

32. H
$-7 + 6 = -1$ ✓

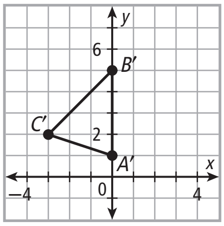
CHALLENGE AND EXTEND

33a. $R''((-2-1)+4, (-2+3)-1) = R''(1, 0)$
$S''((-3-1)+4, (1+3)-1) = S''(0, 3)$
$T''((1-1)+4, (1+3)-1) = T''(4, 3)$

b. $(x, y) \to ((x-1)+4, (y+3)-1) = (x+3, y+2)$

34. $m\angle = \frac{12}{60}(360) = 72°$

35. Transformation is $(x, y) \to (-y, x)$. So vertices of image are $A'(0, 1)$, $B'(0, 5)$, and $C'(-2, 2)$.



36. $(x, y) \to (x, -y)$

37. $(x, y) \to (-x, y)$

SPIRAL REVIEW

38. $0 = x^2 + 12x + 35$
$0 = (x+7)(x+5)$
$x = -7$ or -5

39. $0 = x^2 + 3x - 18$
$0 = (x+6)(x-3)$
$x = -6$ or 3

40. $0 = x^2 - 18x + 81$
$0 = (x-9)^2$
$x = 9$

41. $0 = x^2 - 3x + 2$
$0 = (x-2)(x-1)$
$x = 2$ or 1

42. $m(\text{supp. of } \angle A) = 180 - m\angle A$
$= 180 - 76.1 = 103.9°$

43. $m(\text{comp. of } \angle A) = 90 - m\angle A$
$= 90 - 76.1 = 13.9°$

44. Method 1 Use Dist. Formula. Subst. values for coords. of 2 pts. into Dist. Formula.

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(4-2)^2 + (6-3)^2}$$
$$= \sqrt{2^2 + 3^2}$$
$$= \sqrt{4+9} = \sqrt{13} \approx 3.6$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by 2 pts.

$a = 3$ and $b = 2$
$c^2 = a^2 + b^2$
$= 3^2 + 2^2$
$= 9 + 4$
$= 13$
$c = \sqrt{13} \approx 3.6$

45. Method 1 Use Dist. Formula. Subst. values for coords. of 2 pts. into Dist. Formula.

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(0-(-1))^2 + (8-4)^2}$$
$$= \sqrt{1^2 + 4^2}$$
$$= \sqrt{1+16} = \sqrt{17} \approx 4.1$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by 2 pts.

$a = 1$ and $b = 4$
$c^2 = a^2 + b^2$
$= 1^2 + 4^2$
$= 1 + 16$
$= 17$
$c = \sqrt{17} \approx 4.1$

46. Method 1 Use Dist. Formula. Subst. values for coords. of 2 pts. into Dist. Formula.

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-6-(-3))^2 + (-2-7)^2}$$
$$= \sqrt{(-3)^2 + (-9)^2}$$
$$= \sqrt{9+81} = \sqrt{90} \approx 9.5$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by 2 pts.

$a = 3$ and $b = 9$
$c^2 = a^2 + b^2$
$= 3^2 + 9^2$
$= 9 + 81$
$= 90$
$c = \sqrt{90} \approx 9.5$

47. Method 1 Use Dist. Formula. Subst. values for coords. of 2 pts. into Dist. Formula.

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-1-5)^2 + (3-1)^2}$$
$$= \sqrt{(-6)^2 + 2^2}$$
$$= \sqrt{36+4} = \sqrt{40} \approx 6.3$$

Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by 2 pts.

$a = 6$ and $b = 2$
$c^2 = a^2 + b^2$
$= 6^2 + 2^2$
$= 36 + 4$
$= 40$
$c = \sqrt{40} \approx 6.3$

READY TO GO ON? PAGE 59

1. $P = 2\ell + 2w$
$= 2(20) + 2(8)$
$= 40 + 16 = 56$ in.

$A = \ell w$
$= (20)(8) = 160 \text{ in}^2$

2. $P = a + b + c$
$= 13 + 2x + 20 + 3x - 11$
$= 5x + 22$

$A = \frac{1}{2}bh$
$= \frac{1}{2}(2x + 20)(13)$
$= \frac{1}{2}(26x + 260)$
$= 13x + 130$

3. $P = 2\ell + 2w$
$= 2(6x) + 2(3x + 2)$
$= 12x + 6x + 4$
$= 18x + 4$

$A = \ell w$
$= (6x)(3x + 2)$
$= 18x^2 + 12x$

4. $P = a + b + c$
$= 10 + 5x + 14 + 14x - 2$
$= 19x + 22$

$A = \frac{1}{2}bh$
$= \frac{1}{2}(5x + 14)(10)$
$= \frac{1}{2}(50x + 140)$
$= 25x + 70$

5. $C = 2\pi r$
$= 2\pi(6) \approx 37.7$ m

$A = \pi r^2$
$= \pi(6)^2 = 113.1 \text{ m}^2$

6. $\left(\frac{-4+3}{2}, \frac{6+8}{2}\right) = \left(\frac{-1}{2}, \frac{14}{2}\right) = (-0.5, 7)$

7. **Step 1** Let coords. of K equal (x, y).
Step 2 Use Mdpt. Formula.
$(9, 3) = \left(\frac{6+x}{2}, \frac{-2+y}{2}\right)$
Step 3 Find x-coord.
$9 = \frac{6+x}{2}$
$18 = 6 + x$
$12 = x$

Find y-coord.
$3 = \frac{-2+y}{2}$
$6 = -2 + y$
$8 = y$

The coordinates of K are (12, 8).

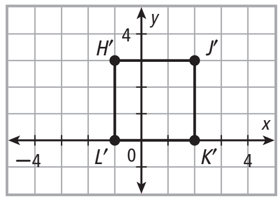
8. **Step 1** Find coords. of each point.
$Q(4, 3)$, $R(-3, 1)$, $S(-2, -4)$, and $T(5, -2)$.
Step 2 Use Dist. Formula.
$QR = \sqrt{(-3-4)^2 + (1-3)^2}$
$= \sqrt{(-7)^2 + (-2)^2}$
$= \sqrt{49 + 4} = \sqrt{53} \approx 7.3$
$ST = \sqrt{(5-(-2))^2 + (-2-(-4))^2}$
$= \sqrt{7^2 + 2^2}$
$= \sqrt{49 + 4} = \sqrt{53} \approx 7.3$
Since $QR = ST$, $\overline{QR} \cong \overline{ST}$.

9. **Method 1** Dist. Formula.
$FG = \sqrt{(-3-4)^2 + (-2-3)^2}$
$= \sqrt{(-7)^2 + (-5)^2}$
$= \sqrt{49 + 25} = \sqrt{74} \approx 8.6$
Method 2 Pyth. Thm. Count the units for the legs of the rt. △ formed by F and G.
$a = 7$ and $b = 5$
$c^2 = a^2 + b^2$
$= 7^2 + 5^2$
$= 74$
$c = \sqrt{74} \approx 8.6$

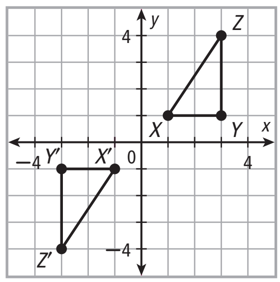
10. reflection; $\triangle ABC \rightarrow \triangle A'B'C'$

11. translation; $PQRS \rightarrow P'Q'R'S'$

12. Vertices of figure are $H(2, 1)$, $J(5, 1)$, $K(5, -2)$, and $L(2, -2)$. Vertices of image are:
$H'(2-3, 1+2) = H'(-1, 3)$
$J'(5-3, 1+2) = J'(2, 3)$
$K'(5-3, -2+2) = K'(2, 0)$
$L'(2-3, -2+2) = L'(-1, 0)$



13.



From graph, transformation is a rotation of 180° about the origin.

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1. angle bisector
2. complementary angles
3. hypotenuse

LESSON 1-1

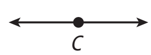
4. A, F, E, G or C, G, D, B

5. Possible answer: $\overleftrightarrow{GC}$

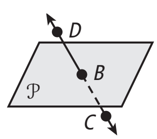
6. Possible answer: plane AEG

7.

8.



9.



LESSON 1-2

10. $JL = |2 - (-1.5)|$
$= |3.5| = 3.5$

11. $HK = |1 - (-4)|$
$= |5| = 5$

12. Use Seg. Add. Post.
$XY + YZ = XZ$
$13.8 + YZ = 21.4$
$YZ = 21.4 - 13.8 = 7.6$

13. Step 1 Find x.
Use Seg. Add. Post.
$PQ + QR = PR$
$3x + 6x + 4 = 14x - 6$
$10 = 5x$
$x = 2$
Step 2 Find PR.
$PR = 14x - 6$
$= 14(2) - 6 = 22$

14. Step 1 Find x.
$TU = UV$
$3x + 4 = 5x - 2$
$6 = 2x$
$x = 3$
Step 2 Find TU, UV, and TV.
$TU = 3x + 4$
$= 3(3) + 4 = 13$
$UV = TU = 13$
$TV = TU + UV$
$= 13 + 13 = 26$

15. Step 1 Find x.
$DE = EF$
$9x = 4x + 10$
$5x = 10$
$x = 2$
Step 2 Find DE, EF, and DF.
$DE = 9x$
$= 9(2) = 18$
$EF = DE = 18$
$DF = DE + EF$
$= 18 + 18 = 36$

LESSON 1-3

16. $\angle VYX$ rt.; $\angle XYZ$ acute; $\angle ZYW$ acute; $\angle VYZ$ obtuse; $\angle XYW$ rt; $\angle VYW$ straight.

17. Step 1 Find x.
Use $\angle$ Add. Post.
$m\angle HJK + m\angle KJL = m\angle HJL$
$13x + 20 + 10x + 27 = 116$
$23x = 69$
$x = 3$
Step 2 Find $m\angle HJK$.
$m\angle HJK = 13x + 20$
$= 13(3) + 20 = 59°$

18. Step 1 Find x.
$m\angle MNP = m\angle PNQ$
$6x - 12 = 4x + 8$
$2x = 20$
$x = 10$
Step 2 Find $m\angle MNQ$.
$m\angle MNQ = 6x - 12 + 4x + 8$
$= 10x - 4$
$= 10(10) - 4 = 96°$

LESSON 1-4

19. only adj.

20. adj. and a lin. pair

21. not adj.

22. $90 - m\angle = 90 - 74.6 = 15.4°$
$180 - m\angle = 180 - 74.6 = 105.4°$

23. $90 - m\angle = 90 - (2x - 4)$
$= (94 - 2x)°$
$180 - m\angle = 180 - (2x - 4)$
$= (184 - 2x)°$

24. $m\angle = 4(90 - m\angle) + 5$
$m\angle = 365 - 4m\angle$
$5m\angle = 365$
$m\angle = 73°$

LESSON 1-5

25. $P = 2\ell + 2w$
$= 2(4x - 1) + 2(3x)$
$= 14x - 2$

$A = \ell w$
$= (4x - 1)(3x)$
$= 12x^2 - 3x$

26. $P = 4s$
$= 4(x + 4)$
$= 4x + 16$

$A = s^2$
$= (x + 4)^2$
$= x^2 + 8x + 16$

27. $P = a + b + c$
$= 8 + x - 5 + 12$
$= x + 15$

$A = \frac{1}{2}bh$
$= \frac{1}{2}(x - 5)(8)$
$= 4x - 20$

28. $P = 2\ell + 2w$
$= 2(5x + 7) + 2(20)$
$= 10x + 54$

$A = \ell w$
$= (5x + 7)(20)$
$= 100x + 140$

29. $C = 2\pi r$
$= 2\pi(21)$
$= 42\pi \approx 131.9$ m

$A = \pi r^2$
$= \pi(21)^2$
$= 441\pi$
$\approx 1385.4 \text{ m}^2$

30. $r = \frac{14}{2} = 7$ ft
$C = 2\pi r$
$= 2\pi(7)$
$= 14\pi \approx 44.0$ ft

$A = \pi r^2$
$= \pi(7)^2$
$= 49\pi \approx 153.9 \text{ ft}^2$

31. $A = \frac{1}{2}bh$
$102 = \frac{1}{2}(17)h$
$h = \frac{2}{17}(102) = 12$ m

LESSON 1-6

32. $Y\left(\frac{3+(-1)}{2}, \frac{2+4}{2}\right) = \left(\frac{2}{2}, \frac{6}{2}\right) = (1, 3)$

33. **Step 1** Let coords. of B equal (x, y).
Step 2 Use Mdpt. Formula.
$(-2, 3) = \left(\frac{5+x}{2}, \frac{0+y}{2}\right)$
Step 3 Find x-coord. Find y-coord.
$-2 = \frac{5+x}{2}$ $\quad 3 = \frac{0+y}{2}$
$-4 = 5 + x$ $\quad 6 = 0 + y$
$-9 = x$ $\quad 6 = y$
The coordinates of B are $(-9, 6)$.

34. **Step 1** Let coords. of A equal (x, y).
Step 2 Use Mdpt. Formula.
$(-2, 3) = \left(\frac{x+(-4)}{2}, \frac{y+4}{2}\right)$
Step 3 Find x-coord. Find y-coord.
$-2 = \frac{x+(-4)}{2}$ $\quad 3 = \frac{y+4}{2}$
$-4 = x - 4$ $\quad 6 = y + 4$
$0 = x$ $\quad 2 = y$
The coordinates of A are $(0, 2)$.

35. **Method 1** Use Dist. Formula. Subst. values for coords. of X and Y into Dist. Formula.
$$XY = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(6-(-2))^2 + (1-4)^2}$$
$$= \sqrt{8^2 + (-3)^2}$$
$$= \sqrt{64+9} = \sqrt{73} \approx 8.5$$
Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by X and Y.
$a = 8$ and $b = 3$
$c^2 = a^2 + b^2$
$= 8^2 + 3^2$
$= 64 + 9$
$= 73$
$c = \sqrt{73} \approx 8.5$

36. **Method 1** Use Dist. Formula. Subst. values for coords. of H and K into Dist. Formula.
$$HK = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-2-0)^2 + (-4-3)^2}$$
$$= \sqrt{(-2)^2 + (-7)^2}$$
$$= \sqrt{4+49} = \sqrt{53} \approx 7.3$$
Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by H and K.
$a = 2$ and $b = 7$
$c^2 = a^2 + b^2$
$= 2^2 + 7^2$
$= 4 + 49$
$= 53$
$c = \sqrt{53} \approx 7.3$

37. **Method 1** Use Dist. Formula. Subst. values for coords. of L and M into Dist. Formula.
$$LM = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(3-(-4))^2 + (-2-2)^2}$$
$$= \sqrt{7^2 + (-4)^2}$$
$$= \sqrt{49+16} = \sqrt{65} \approx 8.1$$
Method 2 Use Pyth. Thm. Count the units for the legs of the rt. △ formed by L and M.
$a = 7$ and $b = 4$
$c^2 = a^2 + b^2$
$= 7^2 + 4^2$
$= 49 + 16$
$= 65$
$c = \sqrt{65} \approx 8.1$

LESSON 1-7

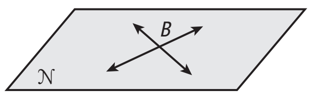
38. 90° rotation; $DEFG \rightarrow D'E'F'G'$

39. translation; $PQRS \rightarrow P'Q'R'S'$

40. $X'(-5 + 4, -4 + 5) = X'(-1, 1)$
$Y'(-3 + 4, -1 + 5) = Y'(1, 4)$
$Z'(-2 + 4, -2 + 5) = Z'(2, 3)$

CHAPTER TEST, PAGE 64

1.



2. Possible answer: D, E, C, A

3. Possible answer: $\overleftrightarrow{BE}$

4. $AB = |0.5 - (-3)|$
$= |3.5| = 3.5$

5. **Step 1** Find x.
Use Seg. Add. Post.
$EF + FG = EG$
$6x - 4 + 3x = 5x + 8$
$4x = 12$
$x = 3$
Step 2 Find EF.
$EF = 6x - 4$
$= 6(3) - 4 = 14$

6. **Step 1** Find x.
$HJ = JK$
$3x + 5 = 9x - 3$
$8 = 6x$
$x = \frac{4}{3}$
Step 2 Find HJ, JK, and HK.
$HJ = 3x + 5$
$= 3\left(\frac{4}{3}\right) + 5 = 9$
$JK = HJ = 9$
$HK = HJ + JK$
$= 9 + 9 = 18$

7. acute

8. rt.

9. obtuse

10. **Step 1** Find x.

$m\angle RTV = m\angle VTS$

$16x - 6 = 13x + 9$

$3x = 15$

$x = 5$

Step 2 Find $m\angle RTV$.

$m\angle RTV = 16x - 6$

$= 16(5) - 6 = 74°$

11. $m\angle = 3(180 - m\angle) - 5$

$m\angle = 540 - 3m\angle - 5$

$4m\angle = 535$

$m\angle = 133.75°$

$m(\text{supp. of } \angle) = 180 - m\angle$

$= 180 - 133.75 = 46.25°$

12. only adj.

13. adj. and a lin. pair

14. not adj.

15. $P = 2b + 2h$
$= 2(8) + 2(4)$
$= 16 + 8 = 24$ ft

$A = bh$
$= (8)(4) = 32$ ft^2

16. $C = 2\pi r$
$= 2\pi(15)$
$= 30\pi \approx 94.2$ m

$A = \pi r^2$
$= \pi(15)^2$
$= 225\pi \approx 706.9$ m^2

17. $r = \frac{d}{2} = 12.5$ ft

$C = 2\pi r$
$= 2\pi(12.5)$
$= 25\pi \approx 78.5$ ft

$A = \pi r^2$
$= \pi(12.5)^2$
$= 156.25\pi \approx 490.9$ ft^2

18. $r = \frac{d}{2} = 1.4$ cm

$C = 2\pi r$
$= 2\pi(1.4)$
$= 2.8\pi \approx 8.8$ cm

$A = \pi r^2$
$= \pi(1.4)^2$
$= 1.96\pi \approx 6.2$ cm^2

19. $\left(\frac{-4 + 3}{2}, \frac{6 + 2}{2}\right) = \left(\frac{-1}{2}, \frac{8}{2}\right) = (-0.5, 4)$

20. **Step 1** Let coords. of N equal (x, y).

Step 2 Use Mdpt. Formula.

$(-5, 1) = \left(\frac{2 + x}{2}, \frac{4 + y}{2}\right)$

Step 3 Find x-coord.

$-5 = \frac{2 + x}{2}$

$-10 = 2 + x$

$-12 = x$

Find y-coord.

$1 = \frac{4 + y}{2}$

$2 = 4 + y$

$-2 = y$

The coordinates of N are $(-12, -2)$.

21. Use Dist. Formula.

$AB = \sqrt{(-1 - (-5))^2 + (3 - 1)^2}$

$= \sqrt{4^2 + 2^2}$

$= \sqrt{16 + 4} = \sqrt{20}$

$CD = \sqrt{(4 - 1)^2 + (1 - 4)^2}$

$= \sqrt{3^2 + (-3)^2}$

$= \sqrt{9 + 9} = \sqrt{18}$

Since $AB \neq CD$, $\overline{AB} \ncong \overline{CD}$

22. 180° rotation; $QRS \rightarrow Q'R'S'$

23. reflection; $WXYZ \rightarrow W'X'Y'Z'$

24. **Step 1** Find the coordinates of $\triangle ABC$.

Vertices of $\triangle ABC$ are $A(-5, 1)$, $B(-2, 4)$, and $C(-1, 1)$.

Step 2 Use $(x, y) \rightarrow (x + 3, y - 3)$ to find vertices of image.

$A'(-5 + 3, 1 - 3) = A'(-2, -2)$

$B'(-2 + 3, 4 - 3) = B'(1, 1)$

$C'(-1 + 3, 1 - 3) = C'(2, -2)$

Step 3